Massachusetts Bay Transportation Authority
PROGRAM FOR MASS TRANSPORTATION
Produced by the Central Transportation Planning Staff
for the Massachusetts Bay Transporttation Authority

THE PROGRAM FOR MASS TRANSPORTATION

Massachusetts Bay Transportation Authority

Deval Patrick, *Governor*
Tim Murray, *Lieutenant Governor*
Jeffrey B. Mullan, *Secretary of Transportation and CEO, Massachusetts Department of Transportation*
William A. Mitchell, Jr., *Acting General Manager, Massachusetts Bay Transportation Authority, and Acting Rail and Transit Administrator, MassDOT*

Project Managers
Joseph M. Cosgrove, *Director of Planning and Development, MBTA*
Elizabeth M. Moore, *Manager of Transit Service Planning, CTPS*

Contributors
Sree Allam
Jonathan Belcher
Annette Demchur
Ben Dowling
Robert Guptill
Ian Harrington
John Hersey
Thomas J. Humphrey
Kathy Jacob
Bruce Kaplan
Sanjay Kaul
Maureen Kelly
Grace King
David Kruse
William Kuttner
Scott A. Peterson
Alicia Wilson

Cartography
Kenneth A. Dumas
Kathy Jacob

Cover and Document Design
Kate Parker-O'Toole

Photography
Carol Gautreau Bent
Kenneth A. Dumas
MBTA Marketing
Kim Noonan

The preparation of this document was supported by the Executive Office of Transportation and Public Works of the Commonwealth of Massachusetts and by the Federal Transit Administration, through §5303 grants MA-80-0001, MA-80-0002, and MA-80-0003, and MBTA Planning Contract X94PS23.

Prepared for the Massachusetts Bay Transportation Authority by the Central Transportation Planning Staff.
CTPS is directed by the Boston Region Metropolitan Planning Organization. The MPO is composed of state and regional agencies and authorities, and local governments.

December 2009

Acknowledgment

The Massachusetts Bay Transportation Authority wishes to recognize the substantive contributions made by the Program for Mass Transportation Stakeholder Advisory Committee. This dedicated group of agency and community representatives, through its active engagement and professional approach to deliberations, provided highly insightful guidance and useful input. Members' commitment to developing a forward-looking regional vision and their ability to articulate the considered views of the organizations and public they represent was of great value in the development of this PMT. Many thanks are extended to each member organization and the representatives.

William A. Mitchell, Jr.
Acting General Manager, MBTA, and Acting Rail and Transit Administrator, MassDOT

PMT Stakeholder Advisory Committee Members

A Better City
Thomas Nally

Access Advisory Committee to the MBTA
Philip Beaulieu, James Oliver

Blue Cross Blue Shield of Massachusetts
Richard Page

Boston Transportation Department
Paul Christner, Vineet Gupta

Chelsea Collaborative
T.J. Hellmann

City of Medford
Ken Krause

Codman Square Neighborhood Development Corporation
Marcos Beleche, Gail Latimore

Executive Office of Housing and Economic Development
Patrick Hart, Mark Siegenthaler

Executive Office of Energy and Environmental Affairs
Marc Breslow

Executive Office of Transportation and Public Works
Steve Woelfel

Livable Streets Alliance
Jeffrey Rosenblum

Massachusetts Bay Transportation Authority
Joe Cosgrove, Ron Morgan, Victor Rivas

MBTA Advisory Board
Paul Regan

MBTA Rider Oversight Committee
Karen Wepsic

Massachusetts Institute of Technology
Nigel Wilson

MassRIDES
Kay Carson

Medical Academic and Scientific Community Organization (MASCO)
Christi Apicella, Ulla Hester

Metropolitan Area Planning Council
Barbara Lucas

Regional Transportation Advisory Committee
Steve Olanoff

Town of Acton
F. Dore Hunter

University of Massachusetts, Boston
Steve Martinson, Susan Wolfson

On November 1, 2009, the Commonwealth implemented a reorganization of its transportation agencies. This reorganization integrated transportation agencies and authorities into a new entity, the Massachusetts Department of Transportation (MassDOT). As of this date, MassDOT oversees four new divisions: Highway, Rail and Transit, Aeronautics and Registry of Motor Vehicles (RMV). All references throughout the PMT of future activities by the Executive Office of Transportation (EOT) will now refer to the new agency – MassDOT.

TABLE OF CONTENTS

CONTENTS PAGE

Introduction ***ix***

Chapter 1 – Challenges and Opportunities ***1-1***

An Under-Funded Transit System with Significant Infrastructure Needs 1-1

Environmental Concerns and Changing Growth Patterns 1-2

Transit Capacity and Meeting Mobility Expectations 1-3

System Accessibility for All 1-4

Quality Customer Service 1-5

Balancing Open Mobility with Safety and Security Concerns 1-5

Equitable Distribution of Benefits and Burdens 1-6

Chapter 2 – Progress Since the Last PMT ***2-1***

Improving Service Reliability 2-2

Reversing Deferral of System Infrastructure Preservation Needs 2-5

Improving Customer Service: Cleanliness, Courtesy, Convenience, and Communications 2-8

Making Transit Service Accessible to All 2-11

Ensuring Safety and Security 2-14

Instituting Best Management Practices 2-15

Instituting New Technologies and Practices to Increase Energy Efficiency and Improve the Environment 2-16

Enhancing and Expanding Service to Increase Ridership and Improve Regional Mobility 2-16

Chapter 3 – The PMT Planning Process ***3-1***

The PMT in the Larger Planning Context 3-1

The PMT Planning Process 3-2

Chapter 4 – Systemwide Context for the PMT ***4-1***

Transit System: Existing Conditions 4-1

Demographic Trends 4-4

CONTENTS (cont.) PAGE

Chapter 5 – Priorities for Achieving a State of Good Repair ***5-1***

Revenue Vehicles 5-2

Non-Revenue Vehicles 5-5

Track/Right-of-Way 5-5

Signals 5-7

Communications 5-8

Power 5-9

Maintenance Facilities 5-9

Stations 5-10

Facilities 5-11

Bridges 5-11

Technology 5-12

Chapter 6 – Opportunities for System Enhancement and Expansion ***6-1***

Systemwide Projects 6-1

Corridor Projects 6-14

Central Area 6-16

Northeast Corridor 6-20

North Corridor 6-22

Northwest Corridor 6-26

West Corridor 6-30

Southwest Corridor 6-32

Southeast Corridor 6-36

Chapter 7 – Illustrative Scenarios ***7-1***

Description of Scenarios 7-2

Modeling Results for Illustrative Scenarios 7-3

Meeting the Evaluation Targets 7-5

Appendix A–Northeast Corridor: Mobility Problems and Proposed Solutions ***A-1***

Appendix B–North Corridor: Mobility Problems and Proposed Solutions ***B-1***

Appendix C–Northwest Corridor: Mobility Problems and Proposed Solutions ***C-1***

Appendix D–West Corridor: Mobility Problems and Proposed Solutions ***D-1***

Appendix E–Southwest Corridor: Mobility Problems and Proposed Solutions ***E-1***

Appendix F–Southeast Corridor: Mobility Problems and Proposed Solutions ***F-1***

Appendix G–Central Area: Boston Proper and Circumferential Mobility Problems and Proposed Solutions ***G-1***

CONTENTS (cont.) PAGE

APPENDIX H: PROJECTS REQUIRED FOR ACHIEVING A STATE OF GOOD REPAIR BY 2030 ***H-1***

APPENDIX I: MODELING SUMMARY RESULTS ***I-1***

FIGURES PAGE

2-1 CIP Funds Budgeted for SGR 2-6

2-2 System Ridership Growth 2-8

2-3 Average Monthly Elevator Reliability SFY 2006–SFY 2009 2-11

2-4 Average Monthly Escalator Reliability SFY 2006–SFY 2009 2-12

3-1 PMT Planning and Programming Process 3-2

4-1 2000 Popuation Density Comparison 4-4

4-2 MBTA Region 2000–2030Population Growth: Top-Ten Communities in Order of Population Increase 4-5

4-3 MBTA Region 2000–2030Employment Growth: Top-Ten Communities in Order of Employment Increase 4-6

4-4 2000 Travel Modes to Work by Boston Region Central Area Residents 4-6

4-5 2000 Travel Modes to Work to Boston and Cambridge by Boston Region Central Area Residents 4-7

A-1 Northeast Corridor 2000–2030 Population Growth: Top-Ten Communitiesin Order of Increase A-4

A-2 Northeast Corridor 2000–2030 Employment Growth:Top-Ten Communities in Order of Increase A-5

A-3 2000 Travel Modes to Work by Northeast Corridor Residents A-8

A-4 2000 Travel Modes to Work by Northeast Corridor ResidentsTo Boston and Cambridge A-8

A-5 Northeast Corridor Trip Increases 2000–2030:Top-Ten in Order of Increase A-9

B-1 North Corridor 2000-2030 Population Growth: Top Ten Communities in Order of Increase B-4

B-2 North Corridor 2000-2030 Employment Growth: Top Ten Communitiesin Order of Increase B-5

B-3 2000 Travel Modes to Work by North Corridor Residents B-5

B-4 2000 Travel Modes to Work by North Corridor Residents to Boston and Cambridge B-8

B-5 North Corridor Trip Increases 2000 - 2030: Top Ten in Order of Increase B-8

C-1 Northwest Corridor 2000-2030 Population Growth: Top Ten Communities in Order of Increase C-4

C-2 Northwest Corridor 2000-2030 Employment Growth: Top Ten Communities in Order of Increase C-5

C-3 2000 Travel Modes to Work by Northwest Corridor Residents C-5

C-4 2000 Travel Modes to Work by Northwest Corridor Residents to Boston and Cambridge C-8

C-5 Northwest Corridor Trip Increases 2000-2030: Top Ten in Order of Increase C-9

D-1 West Corridor 2000-2030 Population Growth: Top Ten Communities in Order of Increase D-4

D-2 West Corridor 2000-2030 Employment Growth: Top Ten Communities in Order of Increase D-5

D-3 2000 Travel Modes to Work by West Corridor Residents D-5

D-4 2000 Travel Modes to Work by West Corridor Residents to Boson and Cambridge D-8

D-5 West Corridor Trip Increases 2000-2030: Top Ten in Order of Increase D-9

E-1 Southwest Corridor 2000-2030 Population Growth: Top Ten Communities in Order of Increase E-4

E-2 Southwest Corridor 2000-2030 Employment Growth: Top Ten Communities in Order of Increase E-5

FIGURES (cont.) PAGE

E-3 2000 Travel Modes to Work by Southwest Corridor Residents E-5
E-4 2000 Travel Modes to Work by Southwest Corridor Residents (Excluding Boston) E-8
E-5 2000 Travel Modes to Work in Boston and Cambridge by Southwest Corridor Residents E-8
E-6 2000 Travel Modes to Work in Boston and Cambridge by Southwest Corridor Residents (Excluding Boston) E-8
E-7 Southwest Corridor Trip Increases 2000-2030: Top Ten in Order of Increase E-9
F-1 Southeast Corridor 2000-2030 Population Growth: Top Ten Communities in Order of Increase F-4
F-2 Southeast Corridor 2000-2030 Employment Growth: Top Ten Communities in Order of Increase F-5
F-3 2000 Travel Modes to Work by Southeast Corridor Residents F-5
F-4 2000 Travel Modes to Work bt Southeast Corridor Residents to Boston and Cambridge F-8
F-5 Southeast Corridor Trip Increases 2000-2030: Top Ten in Order of Increase F-9
G-1 Central Area 2000-2030 Population Growth Top Ten Communities/Neighborhoods in Order of Increase G-4
G-2 Central Area 2000-2030 Employment Growth Top Ten Communities/Neighborhoods in Order of Increase G-5
G-3 2000 Travel Modes to Work by Central Area Residents G-8
G-4 2000 Travel Modes to Work to Boston and Cambridge by Central Area Residents G-8
G-5 Central Area Trip Increases 2000-2030 Top Ten Communities/Neighborhoods in Order of Increase G-9

MAPS

6-1 PMT Corridors 6-15
6-2 Central Area Potential Improvements 6-17
6-3 Circumferential Corridor Potential Improvements 6-19
6-4 Northeast Corridor Potential Improvements 6-21
6-5 North Corridor Outer Area Potential Improvements 6-23
6-6 North Corridor Inner Area Potential Improvements 6-25
6-7 Northwest Corridor Outer Area Potential Improvements 6-27
6-8 Northwest Corridor Inner Area Potential Improvements 6-29
6-9 West Corridor Potential Improvements 6-31
6-10 Southwest Corridor Outer Area Potential Improvements 6-33
6-11 Southwest Corridor Inner Area Potential Improvements 6-35
6-12 Southeast Corridor Outer Area Potential Improvements 6-37
6-13 Southeast Corridor Inner Area Potential Improvements 6-39
A-1 Northeast Corridor of the MBTA Service Area Population Density, 2000 A-2
A-2 Northeast Corridor of the MBTA Service Area Projected Change in Population Density from 2000 to 2030 A-3
A-3 Northeast Corridor of the MBTA Service Area Employment Density, 2000 A-6
A-4 Northeast Corridor of the MBTA Service Area Projected Change in Employment Density from 2000 to 2030 A-7
B-1 North Corridor of the MBTA Service Area Population Density, 2000 B-2
B-2 North Corridor of the MBTA Service Area Projected Change in Population Density from 2000 to 2030 B-3
B-3 North Corridor of the MBTA Service Area Employment Density, 2000 B-6

MAPS (cont.)

		PAGE
B-4	North Corridor of the MBTA Service Area Projected Change in Employment Density from 2000 to 2030	B-7
C-1	Northwest Corridor of the MBTA Service Area Population Density, 2000	C-2
C-2	Northwest Corridor of the MBTA Service Area Projected Change in Population Density from 2000 to 2030	C-3
C-3	Northwest Corridor of the MBTA Service Area Employment Density, 2000	C-6
C-4	Northwest Corridor of the MBTA Service Area Projected Change in Employment Density from 2000 to 2030	C-7
D-1	West Corridor of the MBTA Service Area Population Density, 2000	D-2
D-2	West Corridor of the MBTA Service Area Projected Change in Population Density from 2000 to 2030	D-3
D-3	West Corridor of the MBTA Service Area Employment Density, 2000	D-6
D-4	West Corridor of the MBTA Service Area Projected Change in Employment Density from 2000 to 2030	D-7
E-1	Southwest Corridor of the MBTA Service Area Population Density, 2000	E-2
E-2	Southwest Corridor of the MBTA Service Area Projected Change in Population Density from 2000 to 2030	E-3
E-3	Southwest Corridor of the MBTA Service Area Employment Density, 2000	E-6
E-4	Southwest Corridor of the MBTA Service Area Projected Change in Employment Density from 2000 to 2030	E-7
F-1	Southeast Corridor of the MBTA Service Area Population Density, 2000	F-2
F-2	Southeast Corridor of the MBTA Service Area Projected Change in Population Density from 2000 to 2030	F-3
F-3	Southeast Corridor of the MBTA Service Area Employment Density, 2000	F-6
F-4	Southeast Corridor of the MBTA Service Area Projected Change in Employment Density from 2000 to 2030	F-7
G-1	Central Area of the MBTA Service Area Population Density, 2000	G-2
G-2	Central Area of the MBTA Service Area Projected Change in Population Density from 2000 to 2030	G-3
G-3	Central Area of the MBTA Service Area Employment Density, 2000	G-6
G-4	Central Area of the MBTA Service Area Projected Change in Employment Density from 2000 to 2030	G-7

TABLES

I-a	MBTA Statement of Revenue and Expenses, FY 2001 to FY 2009	x, xi
I-b	MBTA Revenue and Expenses, Pro Forma FY 2010 to FY 2015 No Assumed Fare Increases or Other Additional Relief	xii
I-c	MBTA Capital Investment Program FY 2010 to FY 2014 ($ in millions)	xiv
4-1	Typical Weekday Boardings by Mode (Federal Fiscal Year 2005)	4-2
5-1	Revenue Vehicle Fleet: Remaining Useful Life	5-3, 5-4
5-2	Rapid Transit Track	5-6
5-3	Rapid Transit Signal System Components	5-7
5-4	Bus Maintenance Facilities	5-9
6-1	Station Accessibility Status by Line	6-5
6-2	Key Station Accessibility Status	6-5
6-3	Station Accessibility Enhancement Priorities	6-6 to 6-8
6-4	Parking Enhancement Priorities	6-9, 6-10
7-1	Enhancement Illustrative Scenario: Component Projects	7-2
7-2	Expansion Projects in Illustrative Scenario	7-3

TABLES (cont.)

		PAGE
7-3	Comparison of Illustrative Scenarios	7-4
A-1	Northeast Corridor Station Parking at 85% Usage or Greater	A-12
A-2	Northeast Corridor Bicycle Parking Improvements	A-13
A-3	Northeast Corridor Infrastructure Enhancement Projects	A-14
A-4	Northeast Corridor State-of-Good-Repair Projects	A-15
B-1	North Corridor Station Accessibility Priorities	B-11
B-2	North Corridor Station Parking at 85% Usage or Greater	B-11
B-3	North Corridor Bicycle Parking Improvements	B-12
B-4	North Corridor Infrastructure Enhancement Projects	B-14
B-5	North Corridor State-of-Good-Repair Projects	B-15
C-1	Northwest Corridor Station Accessibility Priorities	C-11
C-2	Northwest Corridor Station Parking at 85% Usage or Greater	C-12
C-3	Northwest Corridor Proposed Bicycle Parking Enhancements	C-13
C-4	Northwest Corridor Proposed Enhancement Projects	C-14
C-5	Northwest Corridor State-of-Good-Repair Projects	C-15
D-1	West Corridor Station Accessibility Priorities	D-12
D-2	West Corridor Station Parking at 85% Usage or Greater	D-13
D-3	West Corridor Bicycle Parking Improvements	D-14
D-4	West Corridor Infrastructure Enhancement Projects	D-16
D-5	West Corridor State-of-Good-Repair Projects	D-17
E-1	Southwest Corridor Station Accessibility Priorities	E-13
E-2	Southwest Corridor Station Parking at 85% Usage or Greater	E-13
E-3	Southwest CorridorBicycle Parking Improvements	E-14
E-4	Southwest Corridor Infrastructure Enhancement Projects	E-17
E-5	Southwest Corridor State-of-Good-Repair Projects	E-18
F-1	Southeast Corridor Station Parking at 85% Usage or Greater	F-12
F-2	Southeast Corridor Bicycle Parking Improvements	F-13
F-3	Southeast Corridor Infrastructure Enhancement Projects	F-15
F-4	Southeast Corridor State-of-Good-Repair Projects	F-16
G-1	Urban Ring Activity Centers	G-12
G-2	Inner-Suburban Activity Centers	G-13
G-3	Outer-Suburban Activity Centers	G-15
I-1	Results of Individual Project Modeling: Ridership	I-2, I-3
I-2	Results of Individual Project Modeling: Air Quality	I-4, I-5

INTRODUCTION

The MBTA's enabling legislation requires the Authority to develop a 25-year "master plan," which must be updated every five years. This plan, the Program for Mass Transportation (PMT), establishes the long-term vision for transit in the region. As a vision document, the PMT is fiscally unconstrained and outlines the universe of potential transit projects that could be built over the next 25 years to achieve the plan's defined goals.

In addition to mandating that the PMT be updated regularly, the MBTA's enabling legislation also requires the Authority to develop an annual Capital Investment Program (CIP). The CIP is a rolling five-year document that programs projects for implementation and identifies funding sources. Unlike the PMT, the CIP is financially constrained: only capital projects the MBTA can afford are included. The PMT and the CIP are complementary planning and programming tools; the PMT planning document defines the capital investment projects that could be implemented to meet the long-range system vision, and the CIP budgetary program document funds the immediate, near-term investment priorities.

At the time of this updated PMT, we find ourselves in a period of deepening economic anxiety, with U.S. and global financial markets in crisis and government at all levels—federal, state, and local—anticipating prolonged recession and consequent budget cutbacks. All public transit agencies are currently facing budget challenges due to price volatility in fuel and energy markets. The fiscal challenges at the MBTA are intensified by projected revenue shortfalls, increased labor costs, and a financial structure that includes a debt burden that is the largest of any at a major transit agency in the country. Tables 1 and 2 below show the MBTA's operating budget since the beginning of Forward Funding in 2001 and a pro forma projection for the next five years, respectively. As can be seen in Table I-a,

TABLE I-a
MBTA Statement of Revenue and Expenses, FY 2001 to FY 2009

REVENUE					
OPERATING REVENUES	**FY2001**	**FY2002**	**FY2003**	**FY2004**	**FY2005**
Revenue from Transportation	280,982,907	283,287,567	274,205,790	295,496,104	319,271,166
Other Operating Revenue	37,721,851	37,831,187	43,361,074	49,440,154	47,751,508
Total Operating Revenues:	318,704,758	321,118,754	317,566,864	344,936,258	367,022,674
NON-OPERATING REVENUES					
Dedicated Local Assessment Revenue	144,553,734	142,872,642	141,142,768	139,437,832	137,732,280
Dedicated Sales Tax Revenue	590,772,447	664,350,000	682,094,554	686,976,316	704,620,528
Other Income	27,739,969	15,007,513	12,686,250	12,813,202	16,705,530
Total Non-Operating Revenues	763,066,150	822,230,155	835,923,572	839,227,349	859,058,339
TOTAL REVENUES	**1,081,770,908**	**1,143,348,909**	**1,153,490,436**	**1,184,163,607**	**1,226,081,013**

EXPENSES					
OPERATING EXPENSES	**FY2001**	**FY2002**	**FY2003**	**FY2004**	**FY2005**
Wages	291,092,991	307,843,432	311,714,068	319,328,460	337,189,978
Fringe Benefits	99,401,191	97,520,302	103,997,754	114,468,705	125,336,543
Payroll Taxes	22,387,234	23,190,933	23,552,709	24,406,912	26,900,012
Materials, Supplies & Services	110,677,687	111,318,591	118,917,517	108,786,619	121,716,973
Casualty & Liability	10,239,156	13,361,808	13,281,755	15,411,442	14,672,240
Purchased Commuter Rail Expenses	172,540,450	185,824,276	192,605,170	213,691,188	216,403,861
Purchased Local Service Expenses	28,996,629	32,131,530	35,172,502	38,327,589	43,985,446
Financial Service Charges	1,504,828	1,544,492	1,546,016	1,834,522	1,801,021
Total Operating Expenses	736,840,166	772,735,364	800,787,491	836,255,438	888,006,076
DEBT SERVICE EXPENSES					
Interest	164,976,429	193,845,930	216,966,041	204,783,748	223,291,802
Principal Payments	111,645,667	131,959,750	110,349,327	117,798,529	95,651,923
Lease Payments	14,918,033	15,261,176	15,908,155	16,423,708	17,577,942
Total Debt Service Expenses	291,540,129	341,066,856	343,223,523	339,005,985	336,521,667
TOTAL EXPENSES	**1,028,380,295**	**1,113,802,220**	**1,144,011,014**	**1,175,261,423**	**1,224,527,743**
Surplus/(Deficit)	53,390,613	29,546,689	9,479,422	8,902,185	1,553,270
Deficiency Fund	(13,130,183)	(1,075,047)	(5,363,232)	(4,770,114)	(1,553,270)
Capital Maintenance Fund	(36,583,800)	(24,116,436)			
NET SURPLUS/(DEFICIT)	**3,676,630**	**4,355,206**	**4,116,190**	**4,132,071**	**0**

TABLE I-a (cont.)
MBTA Statement of Revenue and Expenses, FY 2001 to FY 2009

REVENUE				
OPERATING REVENUES	**FY2006**	**FY2007**	**FY2008**	**FY2009**
Revenue from Transportation	333,095,971	386,487,953	440,961,963	448,751,949
Other Operating Revenue	47,213,995	45,133,618	48,835,439	58,002,689
Total Operating Revenues:	380,309,966	431,621,571	489,797,402	506,754,638
NON-OPERATING REVENUES				
Dedicated Local Assessment Revenue	136,026,829	139,427,540	142,913,229	146,486,060
Dedicated Sales Tax Revenue	711,086,005	733,963,311	755,982,210	767,056,684
Other Income	39,615,533	34,166,997	19,061,077	26,167,562
Total Non-Operating Revenues	886,728,367	907,557,848	917,956,516	939,710,306
TOTAL REVENUES	**1,267,038,333**	**1,339,179,419**	**1,407,753,918**	**1,446,464,944**

EXPENSES				
OPERATING EXPENSES	**FY2006**	**FY2007**	**FY2008**	**FY2009**
Wages	347,845,647	353,664,245	361,508,444	402,881,584
Fringe Benefits	146,386,155	158,339,840	160,040,569	168,893,408
Payroll Taxes	27,455,974	27,479,403	27,336,436	32,816,240
Materials, Supplies & Services	134,304,402	145,355,389	162,826,552	172,911,307
Casualty & Liability	14,191,661	15,605,917	16,231,200	14,923,435
Purchased Commuter Rail Expenses	216,249,789	223,729,831	247,434,243	273,461,652
Purchased Local Service Expenses	49,520,600	54,572,067	60,614,114	67,737,669
Financial Service Charges	1,623,857	1,728,409	1,728,946	4,368,625
Total Operating Expenses	937,578,085	980,475,100	1,037,720,504	1,137,993,920
DEBT SERVICE EXPENSES				
Interest	205,292,656	229,571,436	234,235,624	238,051,078
Principal Payments	113,104,925	112,722,401	116,476,024	84,634,312
Lease Payments	18,270,012	21,110,882	18,621,977	19,093,168
Total Debt Service Expenses	336,667,593	363,404,719	369,333,625	341,778,558
TOTAL EXPENSES	**1,274,245,678**	**1,343,879,819**	**1,407,054,129**	**1,479,772,479**
Surplus/(Deficit)	(7,207,345)	(4,700,400)	699,789	(33,307,535)
Deficiency Fund	7,207,345	4,700,400	0	16,000,000
Capital Maintenance Fund				17,307,535
NET SURPLUS/(DEFICIT)	**0**	**0**	**699,789**	**0**

TABLE I-b
MBTA Revenue and Expenses. Pro Forma FY 2010 to FY 2015
No Assumed Fare Increases or Other Additional Relief

REVENUE						
OPERATING REVENUES	**FY2010**	**FY2011**	**FY2012**	**FY2013**	**FY2014**	**FY2015**
Revenue from Transportation	453,447,330	457,981,803	462,561,621	467,187,237	471,859,109	476,577,701
Other Operating Revenue	72,874,489	73,603,234	74,339,266	75,082,659	75,833,485	76,591,820
Total Operating Revenue	526,321,819	531,585,037	536,900,887	542,269,896	547,692,595	553,169,521
NON-OPERATING REVENUES						
Dedicated Local Assessments	150,148,212	153,901,918	157,749,466	161,693,202	165,735,532	169,878,921
Dedicated Sales Tax	767,019,551	774,689,747	790,183,541	813,889,048	838,305,719	863,454,891
Other Income	23,261,170	23,493,782	23,728,720	23,966,007	24,205,667	24,447,724
Total Non-Operating Revenues	940,428,934	952,085,446	971,661,727	999,548,257	1,028,246,918	1,057,781,535
TOTAL REVENUES	**1,466,750,752**	**1,483,670,483**	**1,508,562,614**	**1,541,818,153**	**1,575,939,513**	**1,610,951,056**

EXPENSES						
OPERATING EXPENSES	**FY2010**	**FY2011**	**FY2012**	**FY2013**	**FY2014**	**FY2015**
Wages	400,613,524	404,619,660	412,712,053	425,093,414	437,846,217	450,981,603
Fringe Benefits	182,281,170	190,800,549	202,503,169	215,595,500	229,633,849	244,690,451
Payroll Taxes	31,584,961	31,892,016	32,539,242	33,515,419	34,520,882	35,556,509
Materials, Supplies & Services	183,805,352	192,995,620	202,645,401	212,777,671	223,416,554	234,587,382
Casualty and Liability	15,535,693	15,846,407	16,163,335	16,486,602	16,816,334	17,152,660
Purchased Commuter Rail Service	280,956,341	295,004,158	309,754,366	325,242,084	341,504,188	358,579,398
Purchased Local Service Subsidy	81,525,339	93,754,140	107,817,261	123,989,850	142,588,327	163,976,576
Financial Service Charges	5,157,569	5,317,272	5,425,514	5,635,515	5,752,311	5,912,438
Total Operating Expenses	1,181,459,949	1,230,229,821	1,289,560,340	1,358,336,055	1,432,078,663	1,511,437,018
DEBT SERVICE EXPENSES						
Interest	266,965,765	257,611,857	258,826,164	261,733,043	261,022,124	259,482,515
Principal Payments	157,325,038	204,913,860	186,562,412	241,218,392	255,192,170	254,394,637
Lease Payments	21,000,000	20,000,000	19,000,000	15,000,000	9,000,000	9,000,000
Total Debt Service Expenses	445,290,803	482,525,718	464,388,576	517,951,435	525,214,294	522,877,153
TOTAL EXPENSES	**1,626,750,752**	**1,712,755,538**	**1,753,948,917**	**1,876,287,490**	**1,957,292,957**	**2,034,314,170**
Surplus/(Deficit)	(160,000,000)	(229,085,055)	(245,386,303)	(334,469,337)	(381,353,443)	(423,363,114)
Deficiency Fund	0	0	0	0	0	0
Capital Maintenance Fund	0	0	0	0	0	0
NET SURPLUS/(DEFICIT)	**(160,000,000)**	**(229,085,055)**	**(245,386,303)**	**(334,469,337)**	**(381,353,443)**	**(423,363,114)**
Additional Tax Revenue from State	**160,394,142**	**160,394,142**	**160,394,142**	**160,394,142**	**160,394,142**	**160,394,142**
NET SURPLUS/(DEFICIT) AFTER RELIEF	**394,142**	**(68,690,913)**	**(84,992,161)**	**(174,075,195)**	**(220,959,301)**	**(262,968,972)**

the MBTA began to struggle with budget deficits in 2006. In the years since then, the MBTA has restructured its debt and used what reserve funds were available to help achieve a balanced operating budget; however, as Table I-b shows, in the current fiscal year (FY), 2010, balancing the budget required an additional allocation from the Legislature of $160 million in state funds over and above the dedicated revenues the MBTA normally receives.

Looking forward, the MBTA's fiscal problems will continue: sizable deficits, driven by growth in debt service costs, will limit the MBTA's ability to make capital investments. Table I-c shows the capital cost projections found in the MBTA's FYs 2010–14 CIP. This table highlights the critical need to invest in buses and trains, the revenue vehicles that the MBTA's customers use every day. Without serious reform in the way that the MBTA is funded, the Authority will need to spend more than it can currently afford simply to maintain and operate the existing system.

While policy makers grapple with reform options aimed at building a sustainable financial model for the MBTA, one issue is certain: over the next 25 years, regional population, employment, and economic growth will place ever greater demands on the Commonwealth's roadway and public transportation systems. Maintaining and expanding a robust and reliable transit network will be critical not only to sustaining the economic well-being of eastern Massachusetts, but also to improving the region's environmental health. The MBTA will be called upon to play a central role in fulfilling public policy goals for energy conservation and greenhouse gas emission reductions. Accomplishing these goals will require that the Commonwealth have in place a reliable, accessible, safe, and convenient transit system with sufficient capacity to accommodate increased regional travel demand and expanded transit mode share.

The PMT planning process provides the decision- making framework for a long-term capital investment strategy that will meet future challenges, and is a unique public forum in which the MBTA outlines its vision for Boston area transit and lays out the options and trade-offs for creating and supporting a world-class transit system. For the MBTA, its first priority is clear: it must fix the existing system and ensure that the backlog inventory of unaddressed infrastructure-preservation needs does not lengthen over the next two decades.

However, as this PMT shows, action toward attaining a full range of goals for 2030 in the areas of regional economic competitiveness, energy independence, and sustainable land use patterns will necessarily entail a more ambitious transit investment agenda, one that greatly expands the system's capacity to move more people—and to move them more frequently and more efficiently—than was forecast in the 20th century. Our age is characterized by a globalized economy in which innovation and mobility of information and people are keys to success.

As stewards of the regional public transit infrastructure that our forefathers presciently began building more than a century ago, we at the MBTA have an obligation to make wise decisions about how the system we have inherited can best be shaped and retooled to meet the needs of a region that is constantly changing and is competing in an interconnected global marketplace. Making those capital investment decisions—allocating scarce transportation resources among many interests and priorities—will require foresight, civic engagement, and planning. It is our hope that the PMT process can set a path toward building a transit system that is responsive to the needs of the generations that come after us, while honoring and respecting the accomplishments of those who came before.

In Chapter 1 of this document we discuss the challenges and opportunities that present themselves as the MBTA looks ahead over the 25-year period addressed by this PMT, while in Chapter 2 we look back at the progress that the MBTA has made toward implementing projects envisioned in the 2003 PMT. In Chapter 3, we explain the PMT planning process and how it fits into the larger planning processes of the region

TABLE 3
MBTA Capital Investment Program FY 2010 to FY 2014 ($ in millions)

Program	Authorized Budget	Spending through FY09	FY2010	FY2011	FY2012	FY2013	FY2014	Total FY2010-2014	Beyond FY2014
Revenue Vehicles	$2,020.0	$917.0	$176.9	$169.9	$233.9	$265.2	$254.3	$1,100.3	$0.0
Non-Revenue Vehicles	$21.3	$3.8	$1.0	$0.5	$4.1	$5.1	$6.9	$17.5	$0.0
Track & Right-of-Way	$236.7	$129.2	$14.7	$17.9	$22.3	$21.4	$31.2	$107.5	$0.0
Signals	$297.8	$147.7	$32.0	$22.4	$38.1	$39.3	$21.4	$150.1	$0.0
Communications	$84.8	$75.2	$9.6	$0.0	$0.0	$0.0	$0.0	$9.6	$0.0
Power	$112.7	$31.7	$22.8	$11.0	$15.4	$10.0	$21.8	$81.0	$0.0
Maintenance	$243.7	$193.1	$21.1	$15.0	$10.0	$4.2	$0.3	$50.5	$0.0
Stations	$694.9	$317.9	$93.6	$68.4	$71.4	$68.8	$74.9	$376.9	$0.0
Facilities	$58.1	$26.6	$10.2	$8.9	$8.3	$4.1	$0.0	$31.5	$0.0
Bridges	$127.8	$21.5	$31.0	$26.1	$28.6	$15.5	$5.0	$106.3	$0.0
Station Management Program	$235.7	$193.6	$5.1	$12.0	$18.0	$7.0	$0.0	$42.1	$0.0
Technology/Other	$224.7	$129.6	$24.9	$24.4	$23.0	$12.3	$10.5	$95.1	$0.0
Accessibility	$340.1	$188.9	$53.1	$43.6	$31.0	$22.0	$1.4	$151.2	$0.0
Enhancement	$632.9	$453.3	$71.2	$58.1	$31.7	$11.3	$7.4	$179.6	$0.0
Expansion	$1,388.6	$1,314.3	$44.8	$17.5	$8.0	$4.0	$0.0	$74.3	$0.0
Statewide Transportation Projects	$1,013.5	$30.4	$41.3	$156.2	$259.3	$229.3	$177.0	$863.1	$120.0
Stimulus Projects	$230.0	$0.0	$99.4	$115.0	$15.7	$0.0	$0.0	$230.0	$0.0
Total	**$7,963.1**	**$4,173.7**	**$752.7**	**$766.8**	**$818.7**	**$719.5**	**$612.0**	**$3,666.6**	**$120.0**

and the state. In this chapter we also outline the vision, goals, and objectives of this PMT, as well as the process by which potential projects were evaluated. To lay out the context in which the development of this PMT occurred, in Chapter 4 we discuss the existing conditions of the transit system and describe demographic, commuting, and congestion trends. In Chapters 5 and 6 we introduce the universe of projects that have been considered in this PMT, with Chapter 5 focusing on system preservation needs and Chapter 6 summarizing enhancement and expansion options. Finally, in Chapter 7 we offer and compare modeling scenarios that illustrate varying levels of investment and the associated benefits of three different approaches to improving transit in the region during the coming 25 years.

CHAPTER 1

Challenges and Opportunities

This chapter lays out, as broad themes, the challenges and opportunities the MBTA faces as it promotes its 2030 vision for transit in the Boston metropolitan region. Meeting the challenges ahead—and seizing the opportunities—will require not only wise capital investment decisions, but also effective advocacy, a clear understanding of system needs and capacities, and a consistent commitment by management and staff at all levels to quality customer service.

AN UNDER-FUNDED TRANSIT SYSTEM WITH SIGNIFICANT INFRASTRUCTURE NEEDS

Forward Funding legislation enacted in 2000 was intended to put the MBTA on a sound financial footing. Instead, with sales tax revenues lower than projected, escalation in operating costs, and the largest debt burden of any major transit agency in the country, the MBTA finds itself in an unsustainable financial position, as documented by the Massachusetts Transportation Finance Commission in 2007 and 2008. Debt service currently represents one-third of the Authority's annual operating budget. The Authority's total debt burden (principal and interest) is $8.1 billion, attributable in large measure to transit expansion commitments undertaken in the 1990s as part of the mitigation for the Central Artery/Tunnel project.

This structural deficit constrains the capacity of the MBTA to reduce the estimated $2.7 billion backlog in system infrastructure needs and, left unresolved over the long term, would threaten the Authority's strategic investment priority of keeping the deferred maintenance backlog from getting larger. Although solutions for adequately financing the MBTA are beyond the scope of the PMT, the Authority's serious

fiscal problems must be addressed long-term in order for the vision, goals, and objectives of the PMT to be achieved.

Given its current funding realities and the pressing need to fix existing transit infrastructure, the MBTA has been compelled to scale back its financing of expansion projects. Under the direction of the Executive Office of Transportation and Public Works (EOT), the Commonwealth is playing a larger role in funding and prioritizing transit service extensions and securing capital and operations financing to support these expansion projects. This policy allows the MBTA to direct its capital funding to system preservation investments, which are essential for safe, reliable, and efficient transit operation.

BUS MAINTENANCE FACILITY

In addition to bringing the system into a state of good repair, the MBTA must invest in the regular maintenance and replacement of assets to keep them in good working condition and to prevent any future deterioration. Critical to the MBTA's success in this endeavor is the adoption of management practices that foster system preservation. The Authority is currently in the process of upgrading its system for tracking its assets and is developing ways in which to better coordinate the ongoing planning processes for identifying and prioritizing asset maintenance and replacement needs beyond the five-year horizon of the CIP. Also needed is a commitment to ensuring that staffing for the maintenance and repair of assets is sustained at appropriate levels.

ENVIRONMENTAL CONCERNS AND CHANGING GROWTH PATTERNS

Consensus in the scientific community that climate change is real and caused by human activities has led to broad acknowledgment that public policy decisions are needed to reverse global warming. In Massachusetts, the transportation sector emits 40% of all CO_2, a major component of greenhouse gases (GHGs).[1] If current development trends in eastern Massachusetts continue, GHG emissions from transportation will grow, as auto use increases and traffic congestion worsens. The regional travel demand model projects that CO_2 emissions from mobile sources would rise by 2030 to a level approximately 20% greater than the 2000 level if no changes were made to the transportation system.

Forecasts made by the Metropolitan Area Planning Council (MAPC) indicate that, under our current growth trends, two-thirds of suburban growth would occur outside already developed areas by 2030. Residential growth would be dispersed throughout the region, and half of the new jobs would be accessible only by car, not transit. The region cannot sustain this type of development long-term. Greener and smarter land use policies are needed to curb GHG emissions from transportation sources by containing suburban sprawl.

The MetroFuture planning initiative led by MAPC for the Boston area advocates an alternative land use future, one that envisions more concentrated development in the inner core and regional urban

1 U.S. Environmental Protection Agency, "Energy CO_2 Emissions by State," http://www.epa.gov/climatechange/emissions/state_energyco2inv.html. Date accessed: November 7, 2008.

centers. Under this scenario, two-thirds of residential and employment growth would occur in areas that are near existing transit service and have compact development patterns. Policies promoting more densification hold the potential for regional growth that is conducive to making transit a more broadly viable alternative to auto use and that accommodates GHG emissions reduction.

In addition to land use changes, demographic trends underway portend an opportunity for achieving greater transit ridership. MAPC projections show that, by 2030, the population in metropolitan Boston over the age of 55 is expected to increase by 78%; one-third of the residents in the region will be seniors. As these baby boomers grow older and retire from driving, demand for transit services will increase as these residents look for ways to maintain their mobility independence.

Already propelling an increase in transit ridership is the recent volatility in energy and financial markets. According to the U.S. Department of Transportation, Americans drove 12.2 billion miles less in June 2008 than in June 2007—a drop of 4.7%—due in large measure to inflation in fuel and energy costs. Even if this turns out to be a short-term trend, a consensus is developing that we cannot continue to build highways to accommodate ever greater volumes of traffic. As traffic congestion worsens and policies are implemented to promote energy efficiency goals, mass transit and other alternatives to the private motor vehicle become more viable options to accommodate growing demand for mobility.

TRANSIT CAPACITY AND MEETING MOBILITY EXPECTATIONS

To meet future demand for transit generated by growth and changing travel behavior, the MBTA must plan and take steps to ensure that the system has sufficient capacity. Currently, more than 1.1 million unlinked transit trips are made daily on the MBTA. The MAPC population and employment projections show that by 2030 unconstrained demand for transit could increase by approximately 500,000–600,000 additional unlinked trips per day, even if the existing transit system is not expanded. To meet the needs of these potential new transit riders, the MBTA must not only build capacity, but also offer a highly attractive alternative to driving. The key to doing so will be a focus on the reliability, convenience, and comfort of services.

CONTENTED MBTA CUSTOMER

On-time performance (OTP) is perhaps the most important measure of service reliability. OTP for the MBTA rapid transit system is generally very good, with all lines and branches surpassing, meeting, or coming close to meeting the MBTA's schedule adherence standard. Bus and commuter rail services currently do not perform as well. In 2004, 94% of trips of all commuter rail lines departed from and arrived at terminals within five minutes of scheduled departure and arrival times. In 2007, only 79% of all commuter rail trips did so.[2] On the bus system, only 60% of all time points measured on all routes currently show buses arriving on time.

2 The MBTA's Service Delivery Policy states that, for a commuter rail line to meet the schedule adherence standard, 95% of all trips must depart from and arrive atterminals within five minutes of scheduled departure and arrival times.

The MBTA's system preservation backlog contributes to reliability problems on all service modes. Aging vehicles and infrastructure cause equipment breakdowns that result in service delays, dropped trips, and speed restrictions. OTP problems on commuter rail are largely attributable to deferred infrastructure needs, such as signal system failures, deficient bridges, or inadequate track layout.

Improving OTP will be critical to attracting ridership, as will ensuring sufficient service frequency. When service is not frequent enough, vehicles can become crowded and uncomfortable for passengers. As ridership grows, the Authority will need to purchase additional vehicles so that routes/lines will not exceed the number of passengers allowed by the MBTA's vehicle load standards. Infrequent service can also make transit less convenient, discouraging use. Expanding geographic coverage—particularly circumferential connections—could increase the convenience of MBTA service, as could decreasing travel times and ensuring that service is available at the times, on the days, and to the destinations desired by existing and potential customers.

SYSTEM ACCESSIBILITY FOR ALL

The MBTA is a national leader among transit agencies in making the strategic investments needed to advance a full-accessibility agenda. It is committed to complying with both the letter and the spirit of the Americans with Disabilities Act (ADA), so that all people with disabilities will be able to use the system in an equitable, effective, and dignified manner.

The MBTA's blueprint for accessibility has been developed in partnership with the Boston Center for Independent Living (BCIL). A 2007 agreement between the Authority and BCIL enumerates many accessibility improvements that must be made in relation to all aspects of MBTA operations.

Some of the specific initiatives that the MBTA will need to complete include:

- Eliminating separate treatment of persons with disabilities, such as remote/uncovered mini-high platforms
- Providing redundant elevators at stations and maintaining and replacing them as needed
- Purchasing accessible vehicles that are compatible with station accessibility features
- Improving overall customer service for people with disabilities through actions such as pulling buses to curb, making all stop announcements, securing wheelchairs on vehicles, ensuring that CSA (Customer Service Agent) assistance is available, using a bridge plate when needed, and improving wayfinding
- Implementing a program for customer input regarding vehicle accessibility design needs

BICYCLE CAGE AT MBTA STATION

Also of importance to MBTA customers is the ease of access to stations and services for those who walk, bicycle, or drive to transit. The MBTA should work closely with municipalities to improve pedestrian access to services and will need to upgrade bicycle amenities at stations. In addition, the MBTA will need to develop strategies to meet demand for station parking. In some cases, this will mean increasing the supply of parking spaces; however, at other stations, parking demand management strategies, including pricing incentives, may be more feasible. Due to the differing characteristics of individual parking facilities, such as

availability of space to expand and land ownership, differing solutions must be considered for the various stations that need improved access.

QUALITY CUSTOMER SERVICE

Our customers rely on MBTA service for getting to their jobs and accomplishing other essential parts of their daily routines. Moving people on time, safely, and courteously is expected. Riders are our greatest assets, and the MBTA must, as part of any ridership growth strategy, continue to focus on customer service, including improved communications. The MBTA looks to employ new technologies in more effectively managing services and in getting more timely and accurate information to customers. Recent developments in technology have made it possible to communicate with customers faster and more accurately; the MBTA has been consistently improving customer communication through investments such as automated stop-announcement capabilities, next-train alert systems, and Web-based trip planning.

At the same time, however, the MBTA cannot neglect basics such as printed schedules that are easily obtainable on vehicles and in stations; posted schedules and maps that are up-to-date; station public-address announcements that are easily understood; stop announcements that are consistently executed; display of relevant information on variable-message signs; readily available information on how to connect from one mode to another; and timely information about unexpected service delays.

BLUE LINE DISPLAY CASE

Of paramount importance is courteous and respectful treatment by front-line MBTA personnel. The MBTA has instituted personnel training programs, has transformed booth fare collectors into Customer Service Agents, and has established a customer care center that consolidates processing and monitoring of all customer inquiries and complaints.

BALANCING OPEN MOBILITY WITH SAFETY AND SECURITY CONCERNS

The nature of transit systems in general, and the age of the MBTA system in particular, pose safety and security challenges. Transit, an essential transportation element of any densely developed urban area, is designed and operated as an open system, making it inherently difficult to monitor and secure. Unfortunately, as demonstrated by attacks in London and Madrid earlier in this decade, this openness, along with the high volumes of users on a successful transit service, makes such systems high-consequence targets for terrorists. The age of the MBTA infrastructure adds to its vulnerabilities, as it was built long before planners anticipated the need to design stations with blast-resistant structures and with open spaces that provide broad fields of vision for easy surveillance.

The MBTA has increased passenger safety and security through its hub station program, which incorporates closed-circuit television monitoring and elevator, escalator, fire, and automated-fare-collection-system alarms. In addition, cameras are being installed on buses to monitor and guard against crime and/or terrorist activities. Protecting passenger safety will also require regular replacement of vehicles when they reach the

HUB MONITORING STATION

end of their useful lives and ensuring that necessary midlife overhauls and ongoing maintenance are carried out. In addition to physical safety, data security is of ever-increasing importance. Critical to data protection will be investment in redundant and secure computer networks and in systems necessary to protect the security of customers making online pass purchases.

Fundamental to all future MBTA safety and security efforts will be ongoing maintenance of existing equipment, infrastructure, and security systems; upgrades/expansions of technologies as needs change; continued efforts to track security threats as they emerge; and implementation of needed safety and security improvements to protect passengers.

EQUITABLE DISTRIBUTION OF BENEFITS AND BURDENS

The Boston region is blessed with a mature, functioning public transit infrastructure that is the envy of other cities. It is an economic-development asset to the region and critically important in connecting communities. Decisions we make at the MBTA regarding provision of service and capital resource allocation have potentially significant impacts on the future of the region we serve.

Of particular concern are the impacts that transit investments may have on environmental justice communities. These are the communities that are made up of census tracts in which many residents are minority and/or low-income.[3] Transit has played an important role in helping to eliminate barriers that have isolated poor and minority neighborhoods, by providing needed mobility options for transit-dependent residents and making connections to employment opportunities. At the same time, transit service by necessity generates some community burdens, such as noise and emissions from in-service vehicles and from vehicle storage or maintenance garages.

In meeting our environmental justice responsibilities, the Authority makes every effort to ensure that minority and low-income communities have access to public information relating to the planning and operation of MBTA services and the opportunity to be meaningfully involved in the planning process. The MBTA is committed to ensuring that no neighborhood or community will be forced to shoulder a disproportionate burden of any negative economic impacts, or of any negative human-health or environmental impacts of pollution or other environmental hazard, resulting from the construction, operation, or maintenance of its facilities.

The Authority is equally committed to ensuring that the benefits of its services are equitably distributed to minority and low-income areas. As required by the federal Civil Rights Act of 1964, the MBTA monitors the equity of its services through its Title VI program, which ensures that the MBTA does not discriminate, either intentionally or unintentionally, in its delivery of services. For the purposes of Title VI, the MBTA defines minority census tracts as ones in which the proportion of minority persons is greater than the average

3 The MBTA defines minority and low-income census tracts based on the requirements for its Title VI monitoring. Minority census tracts are ones in which the proportion of minority persons is greater than the average proportion of minority persons in the MBTA's service area, and low-income tracts are ones in which the median household income is less than 60% of the median household income for the service area.

proportion of minority persons in the service area, and low-income tracts as ones in which the median household income is less than 60% of the median household income for the service area.[4]

Although there are census tracts that are minority and/or low-income scattered throughout the MBTA service area, the majority are located within the core and in the region's other cities. Boston's neighborhoods are minority, with the exception of the downtown area/financial district and South Boston. Parts of Boston are low-income as well as minority. These are concentrated primarily in the South End, Fenway, Roxbury, and parts of Dorchester and Roslindale. In the cities closest to Boston, the largest minority areas are found in Cambridge, Somerville, Everett, Chelsea, Revere, Malden, and Lynn. Smaller areas that are both low-income and minority are located in most of these cities as well. Farther from the core, the areas with the largest minority and low-income populations are located in Randolph, Brockton, Framingham, Worcester, Leominster, Fitchburg, Harvard, Lowell, and Lawrence.

Recent analysis that was completed as a part of the MBTA's 2008 Title VI monitoring shows that almost half (49%) of the MBTA's approximately 182 bus routes are defined as minority and 16% are defined as minority and low-income.[5] Approximately 70% of all bus boardings occur at stops that are in minority census tracts, and about 26% of boardings are in census tracts that are both low-income and minority.

All of the MBTA's heavy rail lines (Red, Blue, and Orange) are classified as minority, but none is low-income. For light rail, the Green Line B and E branches are minority and low-income, and the Mattapan High Speed Line is minority but is not low-income. The Green Line C and D branches are neither minority nor low-income. With respect to boardings, 54% of all heavy rail inbound boardings occur in minority census tracts and 44% in low-income tracts. For light rail, 57% of inbound boardings occur in minority census tracts and 22% in low-income tracts.

Only 2 of the 12 MBTA commuter rail lines are classified as minority (Fairmount and Middleborough/Lakeville), and none is classified as low-income. Of all commuter rail inbound boardings, 20% occur at minority stations and 5% at low-income stations.

Systemwide, on all modes, over half (approximately 52%) of all inbound boardings occur in minority census tracts, 16% in low-income tracts, and 19% in census tracts that are both minority and low-income.

The MBTA remains committed to ensuring that the benefits and burdens of its services are shared equitably both now and in the future.

4 For Title VI, the MBTA has defined two separate service areas: one for the rapid transit and bus systems, and another for the commuter rail system, which is much larger. The average proportions of minority persons in the bus and rapid transit service area and the commuter rail service area are 24.56% and 19.93%, respectively. Sixty percent of the median household income is $32,120 in the bus and rapid transit service area and $32,582 in the commuter rail service area.

5 Commuter rail lines, rapid transit lines, and bus routes are designated as minority and/or low-income if 40% or more of passengers board in minority and/or low-income tracts. In this PMT's discussion of this aspect of each mode, the lines, routes, and tracts classified as "minority *and* low-income" are not included when quantifying how many are simply "minority" or simply "low-income."

CHAPTER 2

Progress Since the Last PMT

The 2003 PMT outlined the actions needed to bring the MBTA transit system into a state of good repair (SGR). It evaluated and prioritized a number of specific enhancement and expansion projects proposed to improve the system and better serve the regional mobility needs of Commonwealth residents. In the intervening years, the MBTA has funded and implemented many of the 2003 PMT priorities.

The transit improvements highlighted in this chapter have been accomplished in spite of the unsustainable condition of the Authority's present financial structure. A 2009 report issued by the MBTA Advisory Board[1] effectively summarized the Authority's financial dilemma:

> For the past several years the MBTA has only balanced its budgets by restructuring debt liquidating cash reserves, selling land, and other one-time actions. Today, with credit markets frozen, cash reserves depleted and the real estate market at a stand still, the MBTA has used up these options. This recession has laid bare the fact that the MBTA is mired in a structural, on-going deficit that threatens its viability.
>
> In 2000 the MBTA was re-born with the passage of the Forward Funding legislation.This legislation dedicated 20% of all sales taxes collected state-wide to the MBTA. It also transferred over $3.3 billion in Commonwealth debt from the State's books to the T's books. In essence, the MBTA was born broke.
>
> Throughout the 1990's the Massachusetts sales tax grew at an average of 6.5% per year. This decade the sales tax has barely averaged 1% annual growth. The underperformance of the sales tax coupled with too much debt has been slowly strangling the T for years. In FY10 the MBTA faces a $160.4 million deficit and without external assistance in the form of debt relief or new revenue the Authority will be forced to make draconian service cuts and impose dramatic fare increases.

1 Source: "Born Broke: How the MBTA Found Itself with Too Much Debt, the Corrosive Effects of This Debt, and a Comparison of the T's Deficit to Its Peers," Brian Kane, MBTA Advisory Board, April 2009.

As noted above, in the absence of new revenues for SFY 2010, the 'T' will be in the unfortunate situation of having to raise fares and/or cut services following a period of historic ridership growth and at a time when demographic change, growth policies, and transportation economics portend a tremendous opportunity to continue to attract new customers for Boston region transit that is reliable, convenient, and affordable. There are ongoing discussions in the Patrick administration and the Legislature regarding transportation reform and new revenues. The product of these deliberations, it is to be hoped, will address the underlying challenges of transportation finance in Massachusetts and put the Authority on a track toward fiscal stability.

Notwithstanding the current situation, it is important to recognize the actions that the MBTA has taken since 2003 to improve its service. Many of these measures have prevented an even more severe financial situation and have established a foundation for ridership growth and improved fiscal management. These accomplishments are described below, organized according to eight principles upon which the MBTA's customer-focused strategy rests.

IMPROVING SERVICE RELIABILITY

- Bus Replacements and Maintenance: The MBTA committed to a program of bus vehicle procurement and maintenance. Early in this decade, the average age of the MBTA bus fleet exceeded 12 years; today it is 5 years and the Authority is carrying out vehicle purchase plans to ensure that the average age will never exceed 7.5 years. Since 2003, the MBTA replaced more than half of its bus fleet through seven vehicle procurements and added system capacity with expanded use of 60-foot articulated buses.

  Specific bus procurements and fleet overhaul initiatives completed or underway since 2003:

  - 44 new Neoplan 60-foot CNG buses were delivered in 2003–2004
  - 124 new NABI 40-foot CNG buses were delivered in 2003–2004
  - 175 new NABI 40-foot CNG buses were delivered in 2004
  - 28 new Neoplan 40-foot Electric Trolley Buses (ETBs) were delivered in 2004. These replaced the 1976 Flyers, which did not include air conditioning and were not ADA (American with Disabilities Act) accessible.
  - 193 new Neoplan 40-foot Emission Control Diesel buses (ECDs) were delivered in 2004–2005
  - 32 new Neoplan 60-foot Dual Mode Articulated buses (DMAs) were delivered in 2004 for use in the Silver Line Waterfront tunnel and surface routes.
  - 310 new New Flyer 40-foot Emission Control Diesel buses (ECDs) were delivered in 2006–2009

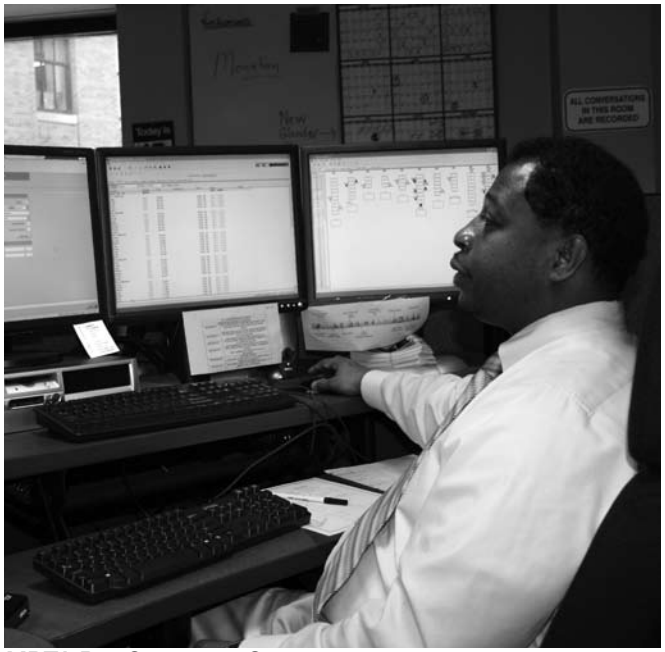
New Flyer 40-foot ECD buses

  - 125 Nova RTS buses were overhauled by MidWest Bus in 2004–2005
  - 123 NABI 40-foot CNG buses are slated to be overhauled by MidWest Bus in 2009–2011

- 175 NABI 40-foot CNG buses are slated to be overhauled in-house by Everett Maintenance Facility in 2009–2011

- Key Route Improvement Program: The Key Route Improvement Program was put in place to reduce crowding and improve on-time performance on the MBTA's most heavily used bus routes (the Key Routes serve 41% of the MBTA bus system ridership). In addition to strategic deployment of operation and inspection resources, the program involves upgrades to customer amenities, including signage, shelters, and map/schedule displays.

- Centralized Monitoring of Bus Operations: Deployed an enhanced bus dispatch system. The centralized bus control center is now in operation, and all buses in the MBTA system have computer-aided dispatch and automatic-vehicle-locator capabilities (CAD/AVL). The CAD/AVL system facilitates more efficient, centralized management of bus operations and improved bus scheduling. This state-of-the-art technology allows the MBTA to better respond to traffic congestion and roadway incidents, especially when coordinated with other local and state transportation agencies that implement traffic signal priority for transit.



MBTA Bus Operations Center

- Moving Customers Faster: Track reconstruction and infrastructure upgrades were implemented, reflecting the MBTA's strategic focus on eliminating subway speed restrictions. In 2003–2009, this resulted in trip-time reductions on the Green Line branch routes ranging from 2–4 minutes on the C Branch to 9–11 minutes on the E Branch. Since 2003, the collective impact of work to remove subway speed restrictions has reduced travel delays by more than 80%.

- Green Line Signal Upgrade: America's oldest subway has new state-of-the art signal systems installed between Science Park and Lechmere Stations, and also between North Station and Haymarket on the Green Line. This includes a new 4-track interlocking at North Station to allow vehicle turnback and storage. New signals between Beaconsfield and Brookline Village Stations should be completed by May 2009.

- Green Line Cars: The addition of the full complement of 95 Type 8 Green Line low-floor vehicles enabled the MBTA to operate more cars and more service during the morning and evening peak periods (the most vehicles ever in service during the peak periods).

- Red Line Cars: Procurement was initiated for No. 4 Red Line cars with estimated production delivery between 2015 and 2019. In addition, selected systems of the No. 2 Red Line fleet are scheduled to be overhauled, with estimated delivery between late 2009 and 2011.

- Columbia Junction Signal Upgrade: Design plans for installing a Columbia Junction signal upgrade are underway. Malfunction of the interlocking system has been responsible for about 20% of the Red Line operating delays.

- New Orange Line Cars: Procurement was initiated for the next generation of No. 14 Orange Line cars, with estimated delivery between 2015 and 2019.

- The Orange Line Haymarket North Signal Upgrade Project: This project was completed in 2008 after three years of construction. It provides automatic train operations on the entire length of the Orange Line, improving reliability and safety, and making shorter vehicle headways possible.
- Orange Line Community College Interlocking: Interlocking was reconfigured to allow Subway Operations to use the third track between Community College and Wellington Stations, providing the opportunity to implement service flexibility and express options responsive to customer demand.
- Wellington Tram: The Wellington tram (which frequently broke down in bad weather) has been replaced with a covered walkway.
- Blue Line Cars: The Blue Line Fleet is being replaced and expanded to 94 cars. The first car in the fleet replacement program was delivered in 2007, and delivery of all vehicles is expected to be completed in 2009.

New Blue Line car

- Blue Line Modernization: All Blue Line Stations underwent station upgrades, including accessibility improvements and platform extensions to accommodate six-car train operations. The modernization program and fleet replacement together produce an effective carrying capacity increase of 50% on the line. Blue Line six-car train operation began in September, 2008. A new diamond crossover and switch turnouts were installed at Orient Heights Yard to accommodate the six-car train operation.
- Commuter Rail Procurements of Coaches and Locomotives: Commuter rail vehicles were procured in connection with restoration of Greenbush service and to increase general capacity.
  - 33 Kawasaki Bi-Level Commuter Coaches delivered in 2005–2006
  - Procurement initiated for 75 Hyundai Rotem Bi-Level Commuter Cars to be delivered 2011–2013
  - Procurement initiated for approximately 20 new locomotives for delivery between late 2012 and early 2014
- Commuter Rail Vehicle Upgrades: The Commuter Rail Coach Reliability and Safety Program was initiated with the goal of upgrading system components (trucks/brake/couplers/HVAC) of 270 coaches. This includes an overhaul to 75 Kawasaki bi-level coaches, planned for delivery in 2012–2015. Delivery of overhauled locomotive engine top decks began in March 2008 and is expected to continue through February 2011.
- Tie and Rail Rehabilitation: New ties, ballast, grade crossings, platforms, and pedestrian walkways installed in the following locations resulted in the removal of speed restrictions and improvement in ride quality:
  - Green Line B Branch along Commonwealth Avenue
  - Green Line C Branch along Beacon Street
  - Green Line E Branch between Brigham Circle and South Huntington Avenue (the roadway was repaved in this section also)

- Green Line Lechmere Viaduct
- Orange Line between Oak Grove and Community College
- Blue Line between Wood Island and Aquarium Stations
- Red Line between JFK and North Quincy Stations
- Red Line on Longfellow Bridge
- Red Line at Columbia Junction
- Red Line at Shawmut Station
- Red Line at Fields Corner Station
- Red Line at North Quincy Interlocking
- Red Line at Clayton Street Curve

- Reducing Motor Failures During Winter: Until 2007, the No. 7 cars on the Green Line and the No. 12 cars on the Orange Line regularly failed when snow accumulations caused electrical short-circuiting of motors. Simple, cost-effective insulation measures were put in place to prevent snow from being ingested into the motors, reducing failures during snowstorms by 30%.
- Vehicle Maintenance Management System: The MBTA implemented a centralized maintenance management system for vehicle maintenance, replacing obsolete systems, improving accountability, and ultimately improving service reliability.
- Maintenance Training: The Maintenance Training Facility was enhanced to include updated equipment to allow for hands-on training on new technology systems.
- Reducing Vehicle Start-Up Failures: Bus Maintenance began using ultra-capacitor technology, first in prototype testing and subsequently in the 310-vehicle bus procurement, to increase system power capacity on MBTA buses and improve performance reliability. The new battery technology will be included in vehicle overhauls and future bus purchases.
- Fort Point Channel Bridge: Construction of a forth track on the Fort Point Channel Bridge eased the congestion bottleneck into South Station from the commuter rail Southampton maintenance facility, the Fairmount Line, and the Old Colony lines.
- Commuter Ferries: In 2007, mid-life overhauls were performed on the two MBTA-owned passenger ferries, and included new fuel tanks, hull repairs, and full repainting.

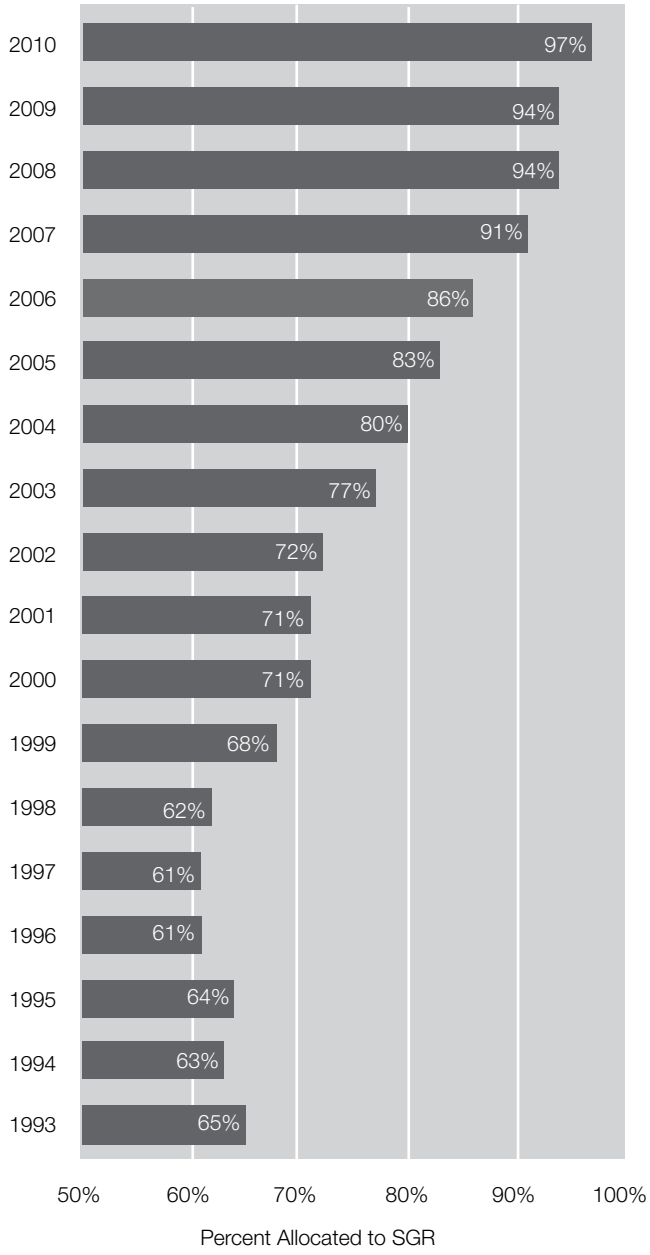
MBTA Harbor Express

REVERSING DEFERRAL OF SYSTEM INFRASTRUCTURE PRESERVATION NEEDS

The MBTA is focusing an increasing share of its capital resources on infrastructure system preservation. In 2003, 77% of the MBTA funds budgeted in the Capital Investment Program (CIP) were directed to state-of-good-repair activities; in the most recent CIP, 97% of MBTA capital dollars go toward infrastructure reinvestment. Based on data analysis from the MBTA asset management system, the Authority must spend at least $470 million annually over 20 years to keep its backlog of deferred maintenance needs from increasing. To achieve a state of good repair systemwide by

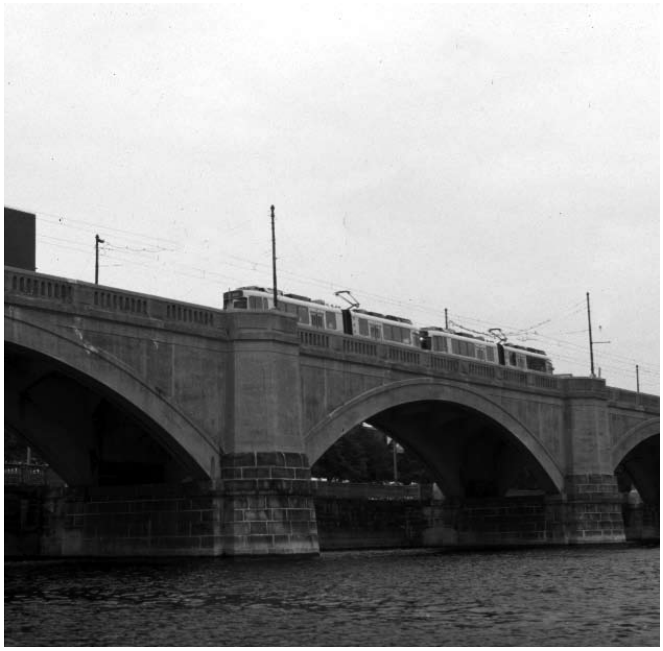
the 2030s, an estimated capital spending level of $620 million annually would be required.

FIGURE 2-1
CIP Funds Budgeted for SGR



Activities undertaken to reduce the state-of-good-repair backlog include:

- Bridge Inspection and Rating: The MBTA owns and maintains over 470 bridges, including bridges that carry commuter rail and transit service as well as highway and pedestrian bridges. Over the past five years, the MBTA instituted a bridge management program, consistent with the National Bridge Inspection Standards, for inspection of every commuter rail bridge annually, inspection of all other bridges every 2 years and load rating calculations every 10 years. This program allows the MBTA to understand the condition of all bridges across the system, to focus repairs as required, and to program bridge replacements.
- Bridge Repair and Rehabilitation: Awarded contracts for the repair of a number of systemwide bridges. Repairs allow the state of good repair to be maintained and extend the useful life of bridges. Among the bridges repaired or rehabilitated within the last five years are:
  - Ruggles busway viaduct
  - Geneva Avenue Bridge
  - Dudley Street Bridge
  - East Cottage Street Bridge
  - Norfolk Street Bridge
  - Lechmere viaduct
- Bridge Replacements: Bridges that have reached the end of their useful life are replaced, subject to available funding. In these instances, the bridge superstructure is replaced and the substructure or foundation is replaced or repaired, depending on the condition. Among the bridges replaced over the past five years are:
  - Hyde Street Bridge
  - Langley Road Bridge
  - Columbia Road Bridge (ongoing)
  - Quincy Street Bridge (ongoing)
  - Massachusetts Avenue Bridge (ongoing)
- Bridge Design: Continued efforts to maintain the state of good repair for MBTA bridges require advanced design. Bridges currently in design for replacement or repair include:
  - Neponset River Bridges (2)



Lechmere Viaduct

  - Dean Road Bridge
  - Clayton Street Bridge
  - Lagrange Road Bridge

- Central Subway Station Upgrades: The Central Subway stations were upgraded through the Revive and Guide Program. Renovations included painting, leak repairs, and replacement of benches, stair treads, and platform edging.
- Red Line Dorchester Branch Station Modernization Program: Stations at Savin Hill, Fields Corner, Shawmut, and Ashmont were reconstructed, with new headhouses, full accessibility, and improved bus-subway connections.
- Mattapan Station Renovation: This project included removal of the old, dilapidated structures at Mattapan and construction of a new terminal (station), including new platforms for buses and the Mattapan High Speed Line and a new building to house Operations and Transit Police staff.
- Mattapan High Speed Line Station Reconstruction: The Mattapan High Speed Line extension stations were refurbished, with additional accessibility features, lighting, and tactile edging.
- Facility Repair: Stations, parking garages, traction power, signal facilities, and all other capital assets must be maintained in a state of good repair. Facility repair projects undertaken include:
  - Alewife garage, structural repairs
  - Blue Line, platform repairs
  - Subway tunnel, inspection and repairs
  - Quincy Ferry, facility improvements
  - South Shore, garages engineering assessment
  - South Boston, environmental abatement
  - Cabot facility, groundwater remediation
  - Cabot bus garage, sprinkler upgrades
  - Cabot bus garage, additional bus bays
  - Charlestown bus garage, heating unit replacement
  - Quincy Ferry terminal, pile repairs
  - Albany bus garage, installation of replacement lifts
  - Quincy bus garage, structural evaluation of inspection pits
  - Everett Maintenance Facility, roof replacement and fire alarm
  - Everett Maintenance Facility, CNG modifications
  - North Cambridge bus facility, new lifts and equipment
  - Orient Heights carhouse, rehabilitation
- Facility Replacement and Construction: A number of facilities across the system replaced in-kind or at alternate locations when existing facilities have reached the end of their useful life. Included in this group of projects are:
  - South Station unit substation, including vent shaft
  - Cabot CNG bus maintenance building

- Arborway CNG bus maintenance building

- Facility Improvements for Vehicles: Protecting the MBTA's investment in vehicles requires ongoing investment in maintenance capacity. Over the past five years, the Everett Maintenance Facility was rehabilitated and converted to service CNG-fueled buses; the Pawtucket commuter rail layover facility opened; and bus garage upgrades, which were planned through the Authority's environmental management system and which improved energy efficiencies and employee safety, were carried out.

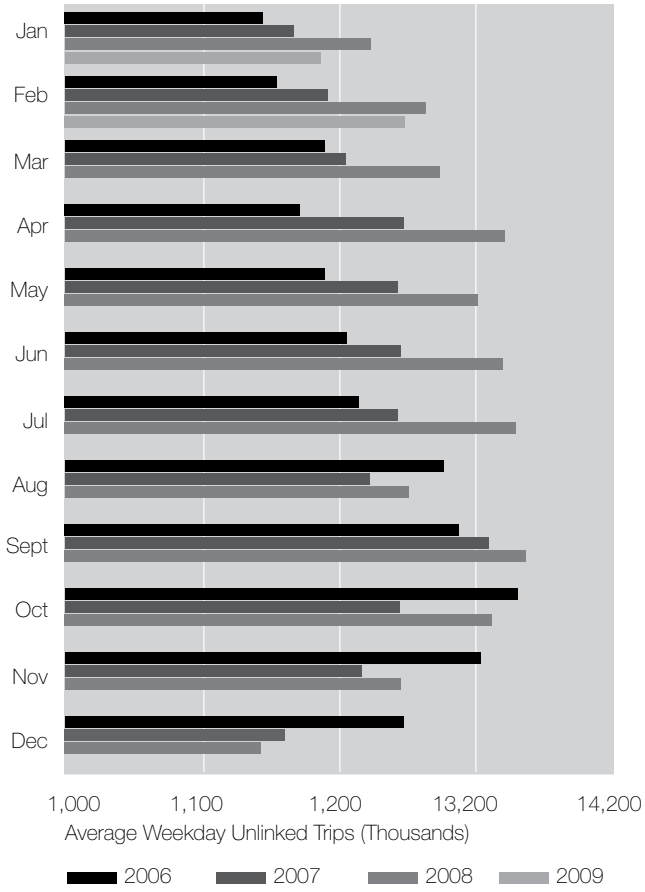
Everett Maintenance Facility reconstruction

- Power System Improvements: The MBTA upgraded power distribution systems through investments that include trackless trolley pole replacement and new transformers at the Wellington and Wonderland Traction Power Substations.

IMPROVING CUSTOMER SERVICE: CLEANLINESS, COURTESY, CONVENIENCE, AND COMMUNICATIONS

- System Ridership Growth: In 2008 the MBTA experienced record ridership, with 1,258,379 average weekday unlinked passenger trips on its system.

FIGURE 2-2
System Ridership Growth



- Automated Fare Collection: The automated-fare-collection (AFC) system was successfully introduced on the bus and rapid transit systems. New fare media and gates replaced tokens and turnstiles in January 2007. By mid-2008, more than 1.2 million CharlieCards were in active use and almost 70% of MBTA bus/subway customer transactions were made with the CharlieCard. In 2007, an additional $13 million of revenue was realized (over and above the fare increase). Plans call for phased expansion of the CharlieCard system to commuter rail and commuter boat between 2009 and 2011. Automated fare collection also reduces fare evasion.

- Station Management Initiative: This initiative, which includes the AFC system, delivered efficiencies and customer service improvements to MBTA Operations. Chief among these efficiencies are time savings in vehicle

boarding and more reliability in data collection and revenue accounting.

- Customer Service Department: The Authority transformed its customer feedback operations by establishing a Customer Service Department to centralize processing of service-related inquiries and complaints. Automatic Call Distribution systems better manage intake, response, and monitoring of customer contacts. The MBTA Customer Care Call Center, on average, processes more than 50,000 customer communications each month.
- Customer Information On-Line: The Authority launched its updated user-friendly website focused on customer service and featuring T service alerts and an interactive trip planner. The MBTA's website, www.mbta.com, has received industry recognition for excellence.
- Customer Communications on Vehicle and In Station: Public Address/Variable Message Signs (PA/VMS) announcing stop locations were installed on all MBTA Buses and Subway Cars. Through the Operations Control Center, the capability is in place to provide the rapid transit system and bus stations with visual and audio announcements via visual electronic signs and a public address system. The system announces the arrival and destination of trains entering stations. This initiative addresses a long-term customer issue by making audible messages intelligible throughout T stations and relaying timely information to customers.
- Public Address/Variable Message Signs for Commuter Rail: Solari information boards and monitors are in use at North Station, South Station, and Back Bay Station. Planning/design is underway for an LED Sign System upgrade to include provision of next-train information; implementation is planned for 2009.
- Connected on the T: Wi-Fi Internet access was introduced on the commuter boat and commuter rail systems.

COMMUTER RAIL CUSTOMERS ENJOYING ONBOARD WI-FI ACCESS

- Silver Line Intelligent Transportation Systems (ITS): Real-time customer information "countdown" messages implemented along Silver Line Washington Street, as well as Traffic Signal Priority (TSP) at four key intersections along the route (which extends the green light for buses operating behind schedule).
- Informing Customers When the Next Vehicle Will Arrive: Began design work on a system-wide real-time customer information system, to provide bus and subway customers with accurate minute-by-minute predictions of vehicle arrivals and departures via electronic signs, mobile devices, the MBTA website, and other devices; two pilot programs are planned for 2009.
- Rider Oversight Committee: The Rider Oversight Committee (ROC) was established in 2004 as a forum for MBTA management to review and discuss Authority operations with customers. The 2009 Committee is comprised of 28 members: eight public members, four alternate public members, eight advocacy members, and eight MBTA members.

- The Committee meets with MBTA staff in standing subcommittees throughout the month. The full membership meets once each month and quarterly meetings are held with the Secretary of the Executive Office of Transportation and Public Works (EOT), the MBTA General Manager, and the Deputy General Manager and Chief Financial Officer.
- The Committee addresses various transit-related issues including MBTA fare policy, fare structure and equity issues, service improvements, service quality standards, ridership data collection as well as financial sources for both the capital program and operating budget.
- Members of the general public are encouraged to participate at the MBTA ROC meetings.

- Making the T Customer Friendly: A recertification program developed to address issues involving courtesy and customer interactions. All bus operators participated in this program, which was implemented in late 2008. The Courtesy Counts marketing campaign was initiated. The campaign focused on customer relations and accessibility issues.
- Less Crowding at North Station: Cramped conditions at North Station were alleviated with the expansion of the station's lobby area. The passenger waiting area quadrupled in size and was outfitted with additional customer seating, as well as with increased commercial-vendor space.
- Cambridge Restroom Improvement Program: Red Line restrooms were renovated and open to the general public.
- Station Cooling: Station cooling devices and fans were deployed in subway stations to improve the customer waiting experience.
- Mattapan High Speed Line HVAC System: The fleet of PCCs built in 1945–1946 were retrofitted with air conditioning and heating units. These are the first PCC cars at the MBTA with HVAC systems.
- Recycling: Through a recently initiated recycling program, more than 550,000 tons of paper have been collected each year, generating revenue for the Authority.

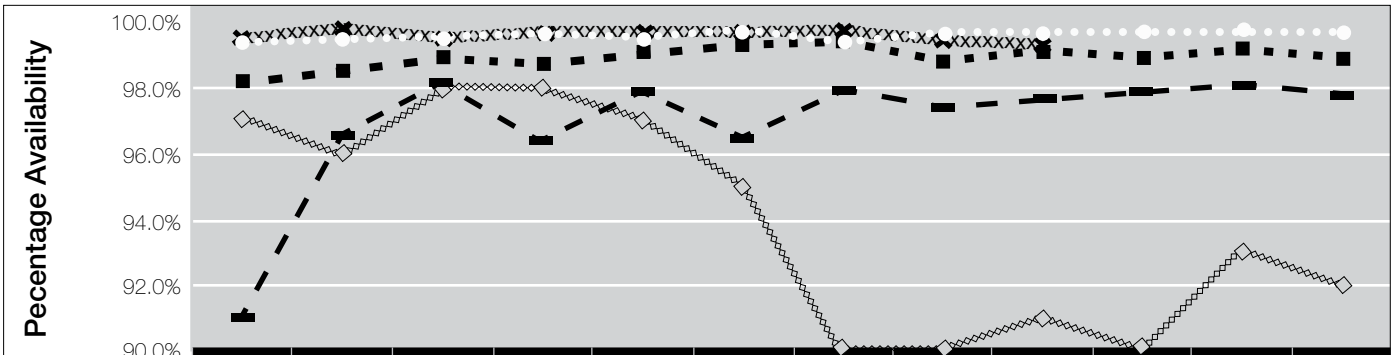
REPOSITORIES FOR THE MBTA'S RECYCLING PROGRAM

- Commuter Rail Windows: Discolored windows were replaced on single-level commuter rail coaches.
- Fiber-Optic Installations: Fiber-optic cable was installed for improved communications at:
  - Green Line D Branch
  - Arborway bus garage
  - Reservoir carhouse
  - Green Line, Science Park to Lechmere
  - Red Line, Central Square to Alewife
  - Green Line, Copley to Symphony
  - Riverside Station and Yard

MAKING TRANSIT SERVICE ACCESSIBLE TO ALL

- Agreement with the Boston Center for Independent Living: A 2006 settlement agreement between the MBTA and the Boston Center for Independent Living sets standards and an implementation agenda for full accessibility. The agreement "is based on a shared vision between the plaintiffs and the MBTA to make the MBTA a model transit system accessible to all. There is a mutual commitment and desire to comply not only with the letter but also the spirit of the Americans with Disabilities Act, with the complete understanding that all people with disabilities must have every opportunity to be fully participating members of our community and that fundamental to this opportunity is the right and ability to use public transportation in an equal, effective, and dignified manner."
- Systemwide Accessibility: The Department of Systemwide Accessibility was created and was charged with overseeing implementation of accessibility commitments, monitoring service performance, investigating customer complaints, and planning future vehicle designs.
- Elevator Reliability: An implementation plan, incorporating new design standards, was put in place for replacing outdated elevators and adding redundant elevators. A new elevator maintenance contract produced significant improvement in elevator performance: availability increased from 90% in 2006 to better than 98% in early 2008. New, state-of-the-art, replacement elevators are currently under design at some stations, including:
  - Alewife Station
  - Porter Square Station
  - Harvard Square Station
  - Park Street Station
  - State Street Station
  - New England Medical Center Station

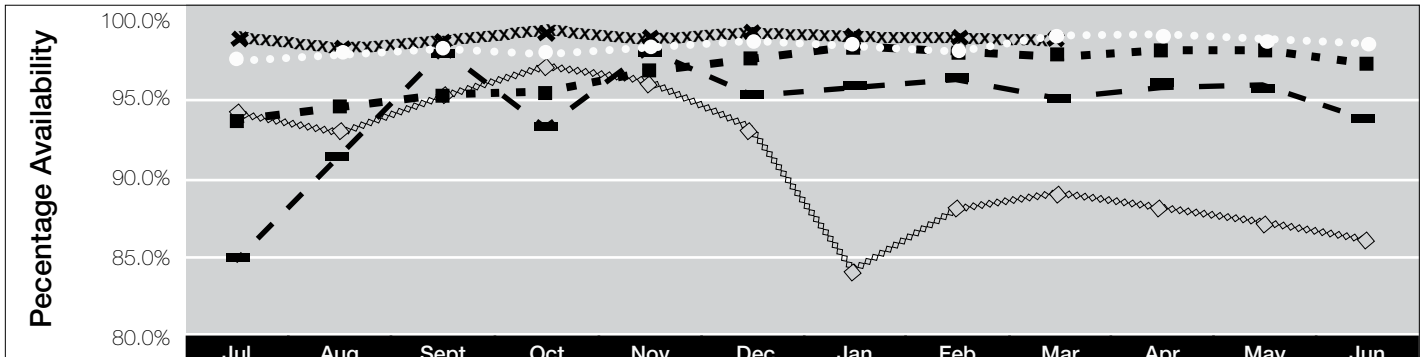
FIGURE 2-3
Average Monthly Elevator Reliability SFY 2006–SFY 2009



	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
FY2005	97.0%	96.0%	98.0%	98.0%	97.0%	95.0%	90.0%	90.0%	91.0%	90.0%	93.0%	92.0%
FY2006	91.0%	96.5%	98.2%	96.4%	97.9%	96.5%	97.9%	97.4%	97.7%	97.9%	98.1%	97.8%
FY2007	98.2%	98.5%	98.9%	98.7%	99.1%	99.3%	99.4%	98.8%	99.1%	98.9%	99.2%	98.9%
FY2008	99.4%	99.5%	99.5%	99.6%	99.5%	99.7%	99.4%	99.6%	99.6%	99.7%	99.8%	99.7%
FY2009	99.5%	99.8%	99.5%	99.7%	99.7%	99.7%	99.8%	99.5%	99.3%			

- Escalators: All escalators to be evaluated and prioritized for replacement and/or modernization (This action anticipated to be complete during the 2nd quarter of 2009). A new contract for Vertical Transportation Consulting Services is in development to accommodate the implementation of the Systemwide Escalator Replacement Program. A program is underway to install escalator operation switches (one key for all units-systemwide) for use by station officials. Installation will coincide with the Escalator Energy Savings Initiative implementation to minimize unit down-time. Other escalator initiatives include an investigation of the feasibility of installing escalator energy savings devices (Results and recommendations expected during the 2nd Quarter of 2009);
- Redundant Elevators: The MBTA commenced a program to introduce additional elevators at a number of heavily used stations across the system. The program will improve service reliability at each of these locations. The stations currently in design include:
  - Porter Square Station
  - Harvard Square Station
  - Park Street Station
  - State Street Station
  - Downtown Crossing Station
- Newly Accessible Stations: As a result of ongoing station accessibility improvements, the following stations became accessible: Charles/MGH, Savin Hill, Fields Corner, Shawmut, Capen Street, Central Avenue, Milton, Butler, and Cedar Grove.
- Station Reconstruction: The MBTA is currently in the process of making a number of stations across the system accessible to people of all abilities. Many of these projects include the introduction of elevators, upgrades to escalators, station modernization, and, on the Green Line, platform elevation. Among the projects completed over the past five years or currently underway are:
  - Savin Hill Station
  - Field Corner Station
  - Shawmut Station
  - Ashmont Station (ongoing)
  - Kenmore Station (ongoing)
  - Copley Station (ongoing)

FIGURE 2-4
Average Monthly Escalator Reliability SFY 2006–SFY 2009



	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
FY2005	94.0%	93.0%	95.0%	97.0%	96.0%	93.0%	84.0%	88.0%	89.0%	88.0%	87.0%	86.0%
FY2006	85.0%	91.3%	91.3%	93.4%	98.1%	95.2%	95.8%	96.3%	95.1%	95.9%	95.7%	93.8%
FY2007	93.6%	94.6%	95.2%	95.4%	96.8%	97.4%	98.4%	98.2%	97.7%	98.1%	98.2%	97.2%
FY2008	97.5%	97.9%	97.9%	97.9%	98.1%	98.7%	98.1%	97.9%	98.9%	99.1%	98.5%	98.5%
FY2009	98.6%	98.1%	98.5%	99.1%	98.6%	98.9%	98.7%	98.7%	98.6%			

- Arlington Street Station (ongoing)
- State Street Station (ongoing)
- Government Center Station (in design)
- Maverick Square Station (ongoing)
- Airport Station
- Orient Heights Station (in design)
- Science Park Station (in design)

- New High-Level and Mini-High-Level Platforms: Mini-high platforms and raised platforms have been deployed in selected stations to replace crank lifts; this allows for faster and easier service for persons with disabilities.
- Fully Accessible Bus Fleet: The bus fleet became 100% accessible in 2006 when older buses were replaced with new low-floor buses.

***MBTA** LOW-FLOOR BUS*

- Public Address/Variable Message Sign System (PA/VMS): The MBTA equipped all buses with automatic-stop-announcement systems that have both visual and audio capabilities, to announce every stop, which further enhanced the system. This was done in response to the settlement agreement with the Boston Center for Independent Living.
- Low-Floor Green Line Cars: The Green Line Type 8 car procurement was completed in 2009, allowing for a low-floor car to operate on every Green Line train. These cars offer faster boarding times for wheelchair users.
- THE RIDE Paratransit Computer System: A state-of-the-art computer system was introduced. It provides:
  - Enhanced scheduling and dispatching capabilities, with integrated mobile data computers on all RIDE vehicles
  - Internet and voice recognition access for customers
  - New electronic fare/debit system
  - Enhanced Automatic Vehicle Locator real-time monitoring tools for Authority personnel
- THE RIDE Fleet: Approximately 635 vehicles, including sedans and lift-equipped vans, provide RIDE service. All vehicles are equipped with radios, Automatic Vehicle Locators (AVL), and Mobile Data Computers (MDC). Digital event recorders have been installed in 200 vehicles. Recent vehicle purchases include:
  - 69 vans and 174 sedans in November 2004
  - 50 vans and 21 sedans in 2006
  - 84 vans in December 2007
  - 42 vans in August and September 2008
- THE RIDE Ridership:
  - Record ridership in SFY 2008 of 1,764,113 trips, up 437% since the passage of the Americans wit Disabilities Act (ADA) in 1990
  - Over 61,000 registered RIDE customers
  - Ridership has increased at least 8% each year since SFY 2006
  - Eligibility applications are averaging 1,400 per month

- THE RIDE Service:
  - 0% trip denials since SFY 2006.
  - On-time service is 98.7% for the category "within 30 minutes of scheduled pickup time," and 92.2% for "within 15 minutes."
  - Complaints have been reduced by 20% for year-to-date SFY 2009, as compared to the prior year.
  - Service contracts for SFY 2010–14 have been approved for all three contractors, with a total contract value of $440 million.
  - THE RIDE supported the newly formed MetroWest RTA by continuing to provide service to Framingham and Natick customers until June 30, 2009.

MBTA Bike Cage Facility

- Bicycles: Cyclist access to the MBTA system expanded significantly, as 50% of the bus fleet was outfitted with front-mounted bike racks; two bike cage facilities (including 6 closed-circuit-television (CCTV) cameras and 2 Police Emergency Call Boxes) were constructed at Alewife to accommodate 300 additional spaces, for a total of approximately 500 spaces; bike parking expanded at other stations as well; and bike coaches were introduced for weekend service on commuter rail.
- Parking: More than 5,300 parking spaces were added to the MBTA system as part of ongoing efforts to meet regional transit access demand. Parking projects that have been completed include Walpole, Gloucester, Lawrence, North Leominster, Fitchburg, Westborough, and Wilmington, as well as station lots on the Greenbush Line.
- Signage:
  - Replaced out-of-date porcelain enamel subway system maps with updated, easier-to-maintain system maps.
  - Added neighborhood maps and bus network maps in subway stations.
  - Deployed route-specific bus stop signs listing the bus routes and destinations at selected stops.
  - Developed a wayfinding signage pilot program at Alewife Station.
- Rowes Wharf: Negotiated a new dock license for Rowes Wharf, paving the way for future improvements to that facility with regard to ADA accessibility.

ENSURING SAFETY AND SECURITY

- Hub Area Network: Hub Area Network was established as a key component of the Station Management Initiative; it includes a system of monitoring subway stations via closed-circuit TV. Hubs are located at Harvard, South Station, North Station, Back Bay, Ruggles, JFK/UMass, and Airport. Subway officials were assigned to these locations to monitor remote areas and verify employee rule compliance, with the added benefit of improving customer safety and security. Security cameras were installed on 310 New Flyer ECD buses, and 17 of the NABI CNG buses were retrofitted with camera systems. Future plans are to retrofit all MBTA buses during their midlife overhaul.

- License Monitoring: Implemented an Automated License Monitoring Program in coordination with the Registry of Motor Vehicles to ensure that every bus operator has a valid license every day.
- Rules Compliance Program Database: Developed a Safety Rules Compliance Program database to record and monitor inspections performed by field officials.
- Homeland Security Needs Assessment: Authority-wide analysis completed in order to facilitate federal funding for improvements.
- Bus Simulator: This equipment replicates a variety of driving conditions designed to improve the skills of both new and veteran drivers. Although the simulator is not a substitute for on-the-road training, which constitutes the majority of the training, it is designed to improve driver skills.
- CCTV: CCTV systems were installed at Charlestown and Cabot bus garages, and in support of the Blue Line six-car-train implementation at Bowdoin, Government Center, State, and Suffolk Downs Stations.

MBTA Operations Control Center – CCTV Upgrade

- Green Line Event Recorder Program: Event recorders were installed at all Green Line interlockings, allowing for data retrieval to aid in incident investigation. These devices capture the status of all wayside signal devices, allow train movements to be replayed, and are useful in diagnosing maintenance problems.
- Interoperability: Transit Police and Metro Fire radio channels were installed at the Operations Control Center at 45 High Street. Cambridge fire and police departments, as well as ITAC channels, were incorporated into the Systemwide Radio Project.
- Emergency Ventilation Fans: Remote monitoring and control units were replaced with programmable logic controllers.
- Fire Alarm Pull Stations: These were installed in Orange Line stations at Forest Hills, Green Street, Stony Brook, Jackson Square, and Massachusetts Avenue.
- Other security features: Other security features that have been implemented include intrusion detection, emergency lighting, and a wide-area-network (WAN) system. This include new door contacts and wiring for emergency exits at 42 transit stations, and new emergency exit crash bars on doors at 8 stations. New key cabinets were installed for improved security.

INSTITUTING BEST MANAGEMENT PRACTICES

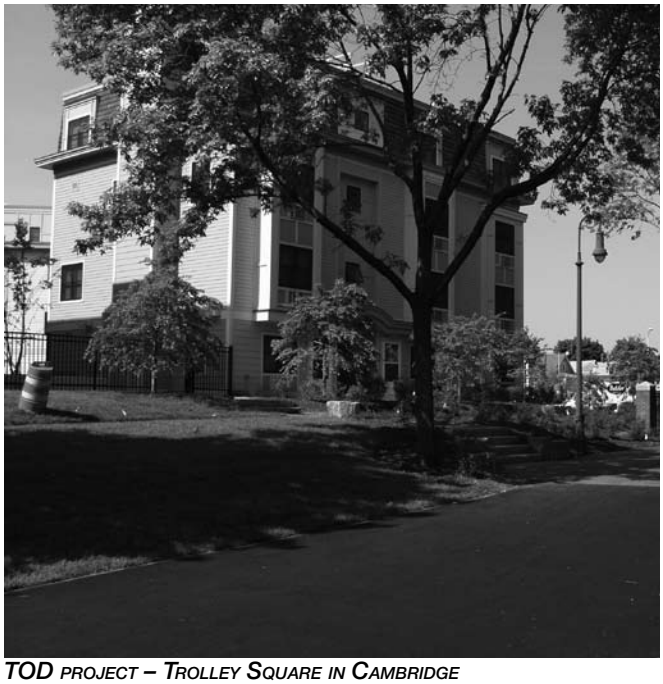
- Attendance Policy Tools: An Attendance Policy tracking and enforcement system was implemented to automate and standardize the process of counting employee absences and determining when corrective action is needed.
- Time Clock: A biometric hand-scanning Time Clock system was implemented in all vehicle and facility maintenance departments to improve accountability.
- Substitute Coverage List Tools: The MBTA

implemented this system to assist in the management of the Substitute Coverage List program, designed to ensure fair and consistent coverage of vacancies in certain critical supervisory positions in Operations.

- Overtime spending in Bus and Subway Operations was reduced 54% from SFY 2005 to SFY 2009, while the Operations employee headcount increased less than 6%, from 4,026 employees in SFY 2005 to 4,267 in SFY 2009.

INSTITUTING NEW TECHNOLOGIES AND PRACTICES TO INCREASE ENERGY EFFICIENCY AND IMPROVE THE ENVIRONMENT

- Transit-Oriented Development (TOD): The MBTA worked with municipalities and the development community in promoting transit-oriented development, which creates new markets for transit while minimizing auto trips and parking requirements. TODs completed since 2003 or currently under construction include the Landing at Wellington Station, Avenir at Bulfinch Triangle near North Station, Arborpoint at Woodland Station, Cordage Park in Plymouth, and the Carruth development at Ashmont Station.
- New Diesel Engines: In 2005, five new diesel engines were procured for the two MBTA-owned passenger ferries to meet the Environmental Protection Agency (EPA) Tier II emissions requirements, at a cost of $795,000.
- Emissions:
  - A Bus Emission Monitoring and Control Program was put in place. All MBTA locations are tested three times per year.
  - The use of low-emission fuels was adopted for the bus fleet and commuter rail.
  - Environmental Management System policies and procedures were instituted in operations facility management.
  - Selected non-revenue vehicles were replaced with Ford Escape hybrid vehicles.
- Environmental Remediation Initiatives Implemented: These include Lynn Bus Garage Gasoline Tank and Dispensing System Removal; Quincy Garage fuel tank replacement; treatment systems installed at maintenance facility bus wash; and maintenance facilities energy conservation projects.



TOD project – Trolley Square in Cambridge

ENHANCING AND EXPANDING SERVICE TO INCREASE RIDERSHIP AND IMPROVE REGIONAL MOBILITY

- Greenbush Line Opening: This new line, the third branch of the Old Colony lines, opened in October 2007, providing new commuting options between Boston and the South Shore. The average daily ridership is over 2,000.
- Expanded Commuter Rail Service: Additional service was provided to the Anderson Regional Transportation Center, Providence, Worcester, and Fitchburg.

- New Station at T. F. Green Airport: The Rhode Island Department of Transportation commenced station construction at T. F. Green Airport. Under the Pilgrim Partnership initiative, the station will be available for MBTA commuter rail service.
- Fairmount Line Improvements: The first phase of the Fairmount Improvement Program has been completed. It included modernization of existing stations and upgrading of the signal system, including interlockings. The second phase, major bridge reconstruction and the addition of four new stations in Roxbury, Dorchester, and Mattapan, is under design; construction should be completed by 2011.
- Silver Line Phase III: The planned bus rapid transit (BRT) tunnel connection between South Station and Boylston Street advanced through preliminary engineering and into the federal New Starts funding process.
- Green Line Extension: EOT initiated project development with the MBTA for a Green Line extension to Somerville and Medford, with operations anticipated to begin by the end of 2014.
- Track Acquisitions for Planned New/Additional Service: EOT, on behalf of the Commonwealth, reached agreement in 2008 with CSX Inc. regarding the purchase of rail corridors. It is anticipated that the Commonwealth will purchase from CSX the New Bedford–Fall River Line, along with CSX's rights in the Boston Terminal Running Track and West First Street Yard in South Boston, and the Grand Junction secondary line that extends from Beacon Park Yard through Cambridge, Somerville, Everett, Chelsea, and East Boston. This agreement is a major advance in promoting expansion of rail service to Fall River and New Bedford, enhanced rail service to Framingham and Worcester, and Urban Ring Phase 2. EOT issued an Action Plan for South Coast Rail and began planning for a commuter rail extension to Fall River and New Bedford. The target date for completion of the project is 2016.
- Red–Blue Connector: EOT, on behalf of the Commonwealth, will complete design and engineering of the Red–Blue Connector by the end of 2011.
- New Commuter Boat Vessel: A third vessel was introduced in 2005 to provide additional AM and PM peak-period commuter boat trips between Hull and Boston. In addition, procurement was initiated for new commuter ferry boats for estimated delivery in late 2011.
- Hingham Shipyard Ferry Terminal Expansion: The MBTA performed a land swap with the Department of Conservation and Recreation in 2006 for land located at the Hingham Shipyard. The MBTA property was privately redeveloped into a 1,796-space parking lot, which includes new access roadways, and improvements to signalization, lighting, curbing, pedestrian walkways, landscaping, and signage.
- Additional Green Line E Branch Service: E Branch peak-period service has dramatically improved, accommodating a long-standing request from Northeastern University and the Longwood Medical and Academic Area. This nearly doubles the number of trains and increases train frequency from 9 to 5 minutes just before and just after the PM peak period.
- Contracted Bus Service in Winthrop: A six-year contract for Route 712/713 bus service between Orient Heights and Winthrop commenced in 2006, with improved scheduling and six new El Dorado low-floor, 35-passenger buses with wheelchair ramps.

CHAPTER 3

The PMT Planning Process

THE PMT IN THE LARGER PLANNING CONTEXT

In setting the MBTA's long-term capital investment agenda, the PMT planning process lays out the system-level foundation, not only for MBTA project development, but also for the regional transit-planning efforts of the Boston Region Metropolitan Planning Organization (MPO). The PMT is also coordinated with the statewide planning efforts of the Executive Office of Transportation and Public Works (EOT).

Regional Transportation Planning

The two legislatively mandated MBTA capital planning and programming documents—the PMT and the Capital Investment Program (CIP)—are coordinated with the federally mandated metropolitan planning organization (MPO) planning process. As a prerequisite to receiving federal transportation funds, each MPO must prepare and approve a 25-year, fiscally constrained Regional Transportation Plan (RTP) at least every four years. In addition, MPOs must annually prepare a Transportation Improvement Program (TIP) that programs federal surface-transportation funds for implementation of projects and priorities consistent with the long-range plan.

MBTA projects included in the RTP or receiving federal funds as programmed in the TIP must also be referenced in the PMT and CIP.

The 175-municipality MBTA service area includes at least parts of the jurisdictions of the following MPOs and regional planning agencies:

- Boston Region Metropolitan Planning Organization and Metropolitan Area Planning Council

- Merrimack Valley Planning Commission
- Northern Middlesex Council of Governments
- Montachusett Regional Planning Commission
- Central Massachusetts Regional Planning Commission
- Southeastern Regional Planning and Economic Development District
- Old Colony Planning Council

Statewide Transportation Planning

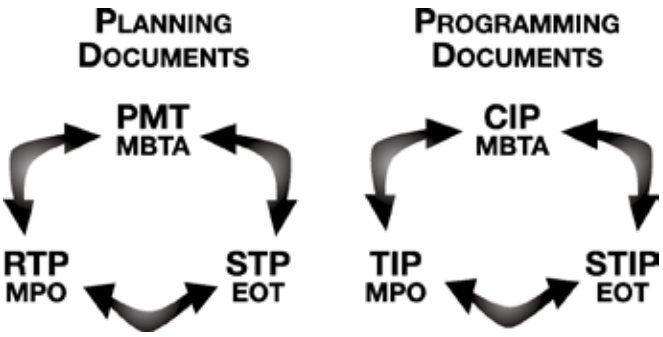
The MBTA, along with seven other transportation agencies/organizations and EOT, is a member of the Massachusetts Mobility Compact, established by Governor Patrick in July 2007. The purpose of the Compact is to improve communication, cooperation, and coordination in transportation planning, design, construction, operation, and maintenance, with the aim of:

- Increasing mobility for people and goods within and through the Commonwealth in a safe, secure, environmentally sustainable, and efficient manner
- Promoting and adopting administrative efficiency and program improvement initiatives between and among transportation agencies and authorities
- Sharing best-practice techniques for implementation across transportation modes

The MBTA is helping to further these goals by coordinating the PMT with EOT's long-range transportation-planning process, "You Move Massachusetts." Designed to be a bottom-up approach to transportation planning, this process began by asking the public to participate in priority setting. Based on the public comments received, a set of core themes was developed; it articulates the expressed concerns, needs, and aspirations of Massachusetts residents for their transportation network. These themes contribute to an overall vision of a transportation system and will guide the development of a multimodal Strategic Transportation Plan (STP) that can both serve and promote a prosperous and sustainable future for the Commonwealth.

As with the MBTA and the MPOs, the Commonwealth also produces a programming document, the State Transportation Improvement Program, or STIP. The STIP, which is prepared annually, is a compilation of the TIPs from the Commonwealth's 10 MPOs and three non-MPO regional planning agencies. As such, the STIP includes the priority transportation projects (highway and transit) for each region in the state by fiscal year.

FIGURE 3-1
PMT Planning and Programming Process



Given the MBTA's well-documented, severe financial constraints, policy makers recognize that the Authority is prevented from using its dedicated capital funding to take on an ambitious expansion project agenda that could divert resources from more immediate infrastructure priorities directly impacting system reliability and performance. The MBTA's first priority is, by necessity, to tackle the estimated $2.7 billion backlog in system infrastructure needs and bring the Boston area transit system into a state of good repair. Realities of the Authority's existing financial structure compel the MBTA to rely on discretionary federal grant funding and Commonwealth funding through EOT to support and advance implementation of major expansion projects.

THE PMT PLANNING PROCESS

The planning approach taken in this PMT reflects the MBTA's priority of fixing the existing system and the central role of EOT and the Commonwealth in prioritizing and paying for transit expan-

sions. Past versions of the PMT have placed particular emphasis on identification and evaluation of potential transit expansion projects. This PMT continues to include transit expansion and capacity improvement projects as important elements for achieving its long-range vision. No region can assume a static transportation system over the coming decades if it aims for sustained economic growth and seeks to make the movement of goods and people more efficient. At the same time, however, this PMT is grounded in twin realities.

First, it is critically important that the PMT process

Grand opening of the Greenbush Line

document the full scope of the regional transit system's existing infrastructure needs. Although the PMT is fiscally unconstrained, the MBTA must also be cognizant of the difficult real-world spending decisions that need to be made in the course of addressing those needs. The MBTA, as steward of the region's transit system, has an obligation to fully communicate the constraints, both fiscal and operational, under which it functions to customers, the transit advocacy community, and policy makers at the state and local levels.

Second, under its existing financing structure—and certainly over the next decade, even if its financing structure were to change—the MBTA will be dependent on non-MBTA funding sources to support transit system expansions. The Commonwealth has already committed to funding the expansion projects required as part of the mitigation for the Central Artery project and scheduled for completion by 2011 and 2014. Other major initiatives in project planning, such as the South Coast Rail extension to Fall River/New Bedford, rapid transit line extensions, and the Urban Ring, will all require state and/or federal funding to design, build, and operate. The planning approach taken in this PMT reflects the MBTA's priority of fixing the existing system and the central role of EOT and the Commonwealth in prioritizing and paying for transit expansions.

Identify Mobility Problems

The key organizing principal for this PMT is identification of mobility problems faced by MBTA customers. The inventory of identified mobility needs is organized geographically into six radial travel corridors: Northeast, North, Northwest, West, Southwest, and Southeast. Also discussed is the central area, which consists of the core and a set of three adjoining circumferential corridors, all of which overlay the radial corridors.

Staff held a series of regional corridor-based workshops in 2007 to engage the public in a dialogue on how the MBTA system works and how it can be improved. At the same time as the public engagement process, staff conducted an internal assessment process at the MBTA, documenting the operating and administrative departments' needs and priorities for bringing the Authority's assets into a state of good repair and maintaining the system in that condition.

Engage Communities and Customers

To focus public input, each PMT workshop dealt with one or two of the radial travel corridors and the mobility issues specific to the mix of services in that corridor and to those connecting that corridor with other corridors.

In addition to workshops, the MBTA used a wide variety of other communication tools to involve the public in the development and review of the PMT. With the assistance of the Boston Region

MPO, the MBTA established a project website that is linked to both the MBTA and the MPO websites. Through the website, interested parties can read general information on the PMT and can link to related documents, as well as those produced during the development of the PMT, such as the vision statement, goals and objectives, project screening criteria, and performance measures. The site also provides an electronic form for citizens to use to register ideas and comments or request more information.

The *PMT Reporter*, the project's newsletter, has also provided information on the development of the PMT. The newsletter is posted on the PMT website and has been mailed to chief elected officials, chief executive officers, and planning boards in the MBTA service area communities outside the MPO region. Individuals who attended public meetings and were interested in receiving the newsletter and other PMT updates

MBTA Program for Mass Transportation

PMT Reporter

APRIL 2007

Improving Mobility in the Boston Region 1
Solving Mobility Problems..... 2
Public Workshop Schedule 3
PMT Stakeholder Advisory Committee Formed 4

The 2008 PMT will focus on improving transit capacity and bringing the MBTA's extensive capital assets into a state of good repair, in order to make service more reliable, convenient, accessible, and safe/secure.

Improving Mobility in the Boston Region

Over the next 15 to 18 months, the MBTA will be seeking input from the public as it develops its long-range planning document, the Program for Mass Transportation (PMT). The PMT outlines a 25-year vision for the Boston region's public transit system, the fifth-largest transit system in the United States, serving 175 municipalities. In the process of developing this document, the MBTA—with your help—aims to identify and prioritize capital investments that will improve the performance of the transit system and keep it in a state of good repair.

Under its enabling legislation, the MBTA is required to update the PMT every five years. This requirement provides the MBTA with the opportunity to revisit the long-range vision and goals for the transit system, as well as the specific projects that are selected to achieve them. It also provides you, as an MBTA customer, with an important opportunity to provide your input.

As a fiscally unconstrained plan, the PMT is the foundation for transit planning in the region. The PMT identifies the universe of transit projects that the Boston Region Metropolitan Planning Organization considers for inclusion in its long-range Regional Transportation Plan (RTP), a 25-year plan for highway and transit projects in the region, and its Transportation Improvement Program, a shorter-term document for implementing RTP projects. The PMT also defines the pipeline of projects that feed into the MBTA's Capital Investment Program (CIP), which is prepared annually and sets the timeline for implementing transit projects.

Historically, the PMT has focused primarily on the identification and evaluation of potential transit expansion projects. However, the MBTA is currently facing a $2.7 billion backlog of maintenance projects that must be addressed to bring the system into a state of good repair and to provide users with reliable, convenient, accessible, and safe/secure transit services. The 2008 PMT will, therefore, also strongly emphasize system preservation projects.

A transit system that provides quality transportation options is crucial for its users and for economic growth and development in the Boston metropolitan area. The MBTA looks forward to hearing your ideas and suggestions for improving mobility in the region.

MBTA Capital Assets

HEAVY RAIL
Red, Orange, and Blue Lines
408 cars, 53 stations,
79 miles of track

LIGHT RAIL
Green Line and Mattapan High Speed Line
209 cars, 78 stations/stops,
46 miles of track

COMMUTER RAIL
13 lines (north and south),
410 coaches, 80 locomotives,
131 stations, 600+ miles of track

WATER TRANSPORTATION
3 privately operated routes, 2 MBTA-owned boats, 2 MBTA-owned docks

BUS AND TRACKLESS TROLLEY
180+ routes, 7,800+ signed stops,
942 vehicles, 8 stations

BUS RAPID TRANSIT
Silver Line Washington Street and Waterfront
12 new stations, dedicated bus lane,
49 articulated vehicles

MAINTENANCE FACILITIES
4 heavy rail, 4 light rail, 3 commuter rail, 9 bus, 17 general service

BRIDGES
285 commuter rail, 58 rapid transit,
86 highway, 44 pedestrian;
610 commuter rail culverts

POWER
165+ substations, 3 million feet of cable, 54 low-voltage switchgears, 390 switch heaters, overhead contact systems, etc.

SIGNALS
419 switches, 1,060 signals, 134 train approach lights, 480 miles of signalized track, 190 miles of aerial pole line, 200 grade crossings with automatic protection equipment, etc.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY 1

THE PMT REPORTER

via email could also join the PMT listserve, which included over 1,700 email addresses.

To advise the MBTA as it developed the 2008 PMT, the Authority established a PMT Stakeholder Advisory Committee (SAC), which represented key agencies/organizations, local governments, transportation advocacy groups, businesses, community development interests, and academia. This committee has served as the MBTA's principal public advisory body in developing the PMT, and has generally met once a month during development of the PMT. Meeting times and locations have been posted on the MBTA's website. The SAC is chaired by the MBTA and includes representatives of the following organizations:

- A Better City
- Access Advisory Committee to the MBTA
- Blue Cross Blue Shield of Massachusetts
- Boston Transportation Department
- Central Transportation Planning Staff
- Chelsea Collaborative
- City of Medford
- Codman Square Neighborhood Development Corporation
- Department of Housing and Community Development
- Executive Office of Environmental Affairs
- Executive Office of Transportation and Public Works
- Livable Streets Alliance
- Massachusetts Institute of Technology
- Mass*RIDES*
- MBTA Advisory Board
- MBTA Rider Oversight Committee
- Medical Academic and Scientific Community Organization, Inc.
- Metropolitan Area Planning Council
- Regional Transportation Advisory Committee
- Town of Acton

- Town of Needham
- University of Massachusetts Boston

Develop Vision, Goals, and Objectives

The vision, goals, and objectives for the PMT incorporate input received through the public process and guidance from the SAC. Although the MBTA solicited information about needed capital expenditures during the public process, many of the comments received dealt with operational or policy issues that affect the quality of service. As a capital planning document, the PMT has not historically included a discussion of these; however, because of the magnitude of the comments, this PMT attempts to incorporate the principles of improving MBTA policies and operations in addition to upgrading the Authority's physical assets.

The PMT *vision* is very broad and articulates the MBTA's role in the Commonwealth's transportation network and its contributions to economic and community vitality. The PMT *goals* provide a concise set of customer-oriented measures that could be taken to achieve this vision, and were the primary driving force behind the formulation of potential mobility solutions. Finally, the PMT *objectives* (which are listed as bullet points below each goal) describe more specific actions that can be taken to achieve the identified goals. Together the vision, goals, and objectives define the desired state of the MBTA's capital facilities at a 25-year horizon.

Utilizing automated fare gates at Blue Line station

Vision

The MBTA will provide safe, reliable, accessible, efficient, and cost-effective services that:

- Meet the evolving mobility needs of the region, the communities, and the individuals it serves
- Reduce environmental impacts
- Support environmental justice
- Strengthen regional economic vitality and competitiveness

Goals and Objectives

The MBTA established the following goals, which, if met, will lead to achievement of the PMT vision. These goals are divided into two types: planning goals and outcome goals. The planning goals address the planning process itself, including steps that the MBTA should take, both internally and externally, to improve its long-range capital planning process.

Planning Goals and Objectives

1. *Strengthen the MBTA's long-range planning process by:*
   - Formalizing coordination of planning efforts among project development, capital programming, operations management, and other areas within the MBTA
   - Standardizing the ongoing process for identifying, prioritizing, and addressing asset maintenance and replacement needs
   - Coordinating with the Commonwealth regarding the implementation of currently planned expansion projects, as well as those identified as future needs, to help solve mobility challenges

2. *Identify mobility strategies for identifiable customer markets within the MBTA's service area by:*
    - Engaging in coordinated land use and transportation planning with local, regional, and state agencies; community organizations; and other key stakeholders
    - Supporting local, regional, and state economic development plans
    - Supporting sustainable, transit-oriented-development plans
    - Conducting a meaningful public process
    - Analyzing existing data to identify and forecast travel patterns

Outcome Goals and Objectives

The projects evaluated in the PMT planning process are selected for their potential to achieve the PMT's long-range vision by meeting the following goals:

1. *Take customers where they need to go*
    - Improve transit connections (geographically as well as within and between modes) and reduce transfers
    - Coordinate MBTA services and fare collection systems with other (non-MBTA) services, including inter-suburban service provided by regional transit authorities (RTAs)
    - Expand options for customers to conveniently access MBTA stations and services
    - Add stops and stations where necessary to meet regional mobility demand and consolidate stops where doing so would increase ridership and improve travel time
2. *Take customers when they need to travel*
    - Improve service frequency
    - Decrease travel times
    - Increase the hours of service, particularly in the evening and late at night
    - Increase off-peak and weekend service
3. *Give customers safe, comfortable service they can rely on*
    - Improve operational safety and security
    - Improve schedule adherence (through right-of-way improvements, signal coordination, intelligent transportation systems technologies, etc.)
    - Provide sufficient service to meet customer demand and reduce passenger crowding.
    - Provide customer amenities such as shelters, heated waiting areas, benches, and bike racks

COMMUTER BIKE CAGE AT MBTA STATION

    - Ensure consistent operation of vehicle air conditioning and heating systems, and station elevators and escalators
    - Improve vehicle design and configuration
    - Provide clean stations and vehicles
4. *Treat customers fairly and with respect*
    - Ensure that the benefits and burdens of the transportation system are equitably distributed
    - Make the system accessible to persons with disabilities

- Provide courteous and responsive customer service
- Provide training for drivers in how to be more courteous and responsive to customers
- Provide drivers with strategies to deal with difficult or dangerous situations
- Develop clear policies for drivers to follow and reward them for implementing them consistently
- Provide incentives and rewards for drivers who excel in customer service

5. *Keep customers well informed*
   - Improve and increase station signs and maps
   - Translate signage, etc., for limited-English-proficiency populations, including tourists
   - Ensure that stop announcements are accurate, audible, and consistently implemented
   - Make schedules readily available
   - Market MBTA services to make the public aware of their options
   - Provide real-time information on the MBTA's website

MBTA WEBSITE

   - Improve Web-based tools that assist customers in planning their trips

6. *Improve the MBTA's impact on regional transportation and environmental protection*
   - Increase transit ridership and the ratio of transit trips to auto trips in the region
   - Reduce emissions of air pollutants and greenhouse gases
   - Reduce other transportation-related pollution of the environment

Develop Problem Statements and Identify Potential Mobility Solutions

The mobility challenges identified during the public process or from other sources, including data analysis and review of existing studies and reports, are grouped by corridor. For each corridor, a problem statement was developed that includes background information such as demographic and travel trends, and the mobility challenges specific to the corridor. Potential solutions to the mobility challenges for each corridor are also found in the corridor problem statements. The mobility solutions include projects for system preservation, service enhancement, and system expansion.

Problem statements for the six radial corridors and the central area (which consists of the core and three surrounding circumferential corridors) are included in Appendices A–G of this document.

Evaluate Mobility Solutions Using Evaluation Criteria

Each of the potential service enhancement and system expansion solutions identified to address the problems in the problem statements was screened to ensure that it would be technologically feasible and consistent with MBTA operations service standards/goals. Solutions that met these screening criteria were advanced to a more detailed assessment. In addition, the Commonwealth's legal commitments were considered

at that stage to identify solutions that must be part of the PMT's final set of mobility strategies.

Most of the potential solutions advanced were measured according to applicable evaluation criteria linked to the PMT goals and objectives. Some projects were not evaluated individually within the context of the PMT. These include projects that are currently being evaluated by the state and for which the final alternative has not been determined, as well as projects that are still at a conceptual stage and have not yet entered the planning process.

The PMT evaluation criteria are presented below. They include both quantitative and qualitative measures that correspond to the PMT goals and objectives. The customer conveyance criteria are organized here to parallel the PMT objectives presented earlier in this chapter.

Service Enhancement and System Expansion Evaluation Criteria

Customer Conveyance

System Configuration

- Reduction in number of transfers/minimization of transfer time
- Improvements to Interconnectivity between modes (including fare collection)
- Improvements to station access
- Expansion of transit access to geographical areas underserved by transit

Expediency

- Improvements to service frequency
- Increase in travel speed
- Reduction in travel time
- Reduction in automobile travel time advantage
- Expansion of transit access during time periods poorly served by transit

Reliability and Comfort

- Improvements to reliability of service
- Expansion of capacity where and when crowding occurs
- Improvements to vehicle comfort and passenger circulation

Fairness

- Elimination of barriers to efficient travel between key destinations and neighborhoods with substantial minority or low-income population.
- Provision of benefits that outweigh burdens in neighborhoods with substantial minority or low-income population.

Customer Information

- Improvements to reliability and quality of stop announcements
- Improvements to availability of real-time service performance data

Regional Transportation Impacts

- Number of transit riders served
- Number of new transit riders served
- Change in transit mode share for the regional network
- Reduction in regional emissions

Land Use Impacts

- Consistency with local plans that promote coordinated, transit-oriented development and support sustainable land use patterns
- Contribution to attainment of MPO land use goals
- Contribution to brownfield and infill development

Customer Support and Safety

- Enhancements to customers' personal safety
- Provision of amenities where customers access service
- Enhancements to vehicle and station cleanliness
- Improvements to responsiveness and courtesy of employees

MBTA EMPLOYEE CLEANING STATION ELEVATOR

- Improvements to safety and security training for operators
- Improvements to navigational tools
- Expansion of schedule availability
- Provision of customer information in languages other than English

Accessibility

- Number of transit riders served
- Improvements to ease of transfers between rail lines
- Improvements to ease of transfers between rail lines and other transit modes
- Expansion of access to major activity centers

State-of-Good-Repair Evaluation Criteria

- Replacement of an asset that has reached or exceeded its useful life
- Correction of an existing deficiency for passengers and/or employees in safety, health, and/or the environment
- Improvement of an operationally critical asset

Establish Evaluation Targets

For each of the quantitative PMT objectives for which progress towards meeting them can be measured, an attempt was made to set a specific performance target for the year 2030. The targets are to be used for two purposes: first, to gauge the effectiveness of proposed projects in relation to PMT expectations during the evaluation process; and, second, to provide benchmarks against which progress can be measured in the future. For some objectives, it was much more difficult than for others to assign a realistic target.

The primary objectives for which targets were established are ridership, travel time, and environmental impacts. The following are the ridership and travel time targets:

- Increase ridership systemwide by 1% per year, or at least 250,000 new unlinked trips/day, between now and 2030
- Reduce average trip travel time by 2% by 2030

Massachusetts is a party to the New England Governors/Eastern Canadian Premiers Climate Change Action Plan that was adopted in August 2001. This plan set the following greenhouse gas (GHG) emission reduction targets, which were incorporated into the Massachusetts Climate Protection Plan in 2004:

- Short-term: Reduce GHG emissions to 1990 levels by the year 2010
- Medium-term: Reduce GHG emissions to 10% below 1990 levels by the year 2020
- Long-term: Reduce GHG emissions sufficiently to eliminate any dangerous threat to the climate; current science suggests this will require reductions to as much as 75%–85% below current levels

Making transit more convenient and reliable is critical to GHG emission reductions in the region. Yet, transit improvements alone, in isolation from the regional transportation network, cannot achieve these very ambitious targets.

Transit must be a component of an overall land use–transportation strategy that fosters changes in travel behaviors, improves intermodal connections, increases system capacity, and puts in place incentives for energy conservation and green technology.

The MBTA is committed to being a full partner with all agencies in Massachusetts state government in working toward meaningful emission reductions and achieving the Commonwealth's climate change goals.

Evaluate Illustrative Scenarios

Using the regional travel demand model, three scenarios were evaluated to illustrate varying levels of future systemwide capital investment and the progress toward achieving the evaluation targets attributable to each. These scenarios are discussed in detail in Chapter 7.

State-of-Good-Repair (SGR) Scenario

The state-of-good-repair (SGR) scenario assumes that all capital investment funds are dedicated to fixing the existing infrastructure. The MBTA system is brought into SGR under this program, which fully addresses deferred and ongoing system preservation needs over the next 25 years. This SGR scenario does not include enhancements or expansion of the system, but provides the baseline against which the enhancement and expansion scenarios are compared.

Enhancement Scenario

The enhancement scenario assumes that the system has been brought to SGR. Beyond achieving SGR, this scenario includes a package of infrastructure investments that would improve the efficiency and effectiveness of the existing system without major expansions of service or capacity.

Expansion Scenario

The expansion scenario assumes that the system has been brought to SGR and that projects in the enhancement scenario have been implemented. Additionally, a group of investments that enlarge system services and capacity would be implemented.

CHAPTER 4

Systemwide Context for the PMT

TRANSIT SYSTEM: EXISTING CONDITIONS

Overview

The Boston metropolitan area is served by an extensive transit system comprising several complementary components. One component is a hub-and-spoke radial network of rapid transit, express bus, commuter rail, and commuter boat lines that is geared, during peak operations, to efficiently move large volumes of people into and out of the urban core for weekday commutes. Local bus and trackless trolley services fill in gaps and connect the radial "spokes" by offering line haul service in heavily congested urban areas, feeder service to rail, and some inter-suburban linkages. Demand-responsive transportation for people with disabilities and the elderly is also provided.

The MBTA is the primary transit provider in the Boston region. The MBTA district is made up of 175 cities and towns and includes communities outside of the 101 municipalities of the Boston Region Metropolitan Planning Organization area. The MBTA also provides commuter rail service to Providence, Rhode Island, which lies outside the MBTA district.

As can be seen in the following table, almost 99% of daily boardings are on the MBTA's primary modes: rapid transit (heavy rail and light rail), bus rapid transit (BRT), bus/trackless trolley, and commuter rail.

TABLE 4-1
Typical Weekday Boardings by Mode
(Federal Fiscal Year 2007)

Mode	Boardings
Rapid transit	730,525
Bus (including trackless trolley and BRT)	355,558
Commuter rail	140,825
Commuter boat	4,900
Paratransit	5,173
Contracted bus*	4,650
Total	1,241,631

*Bus service that is subsidized by the MBTA, but operated by a private vendor.

Source: MBTA, "Ridership and Service Statistics," Eleventh Edition, 2007.

Rapid Transit

The MBTA rapid transit system consists of three heavy rail lines—the Red, Orange, and Blue Lines—and two light rail lines—the Green Line and the Mattapan High Speed Line. These are described below.

- Red Line: A 21-mile heavy rail line with 22 stations that runs from Alewife Station in North Cambridge to JFK/UMass Station in North Dorchester, where it splits into two branches, one that ends at Ashmont Station in South Dorchester and another that ends at Braintree Station in Braintree. The Red Line is the longest and most heavily utilized rapid transit line in the system.
- Mattapan High Speed Line: A 2.5-mile, 8-station light rail line connecting with the Red Line and operating between Ashmont Station and Mattapan, through the Dorchester neighborhood of Boston and the town of Milton.
- Orange Line: An 11-mile heavy rail line with 19 stations, operating between Oak Grove on the Malden/Melrose line and Forest Hills in Jamaica Plain.
- Blue Line: A 6-mile, 12-station heavy rail line, the shortest of the rail rapid transit lines, operating between Wonderland Station in Revere and Bowdoin Station in the Government Center area of Boston.
- Green Line: A 23-mile light rail line over four branches: Boston College (B Line), Cleveland Circle (C Line), Riverside (D Line), and Heath Street (E Line). The Green Line has 66 stops/stations and operates in Boston, Brookline, Cambridge, and Newton.

Bus Rapid Transit

The MBTA operates one BRT route, which consists of two sections that are not yet connected. Silver Line Washington Street operates for 2.3 miles along Washington Street between Dudley Square in Roxbury and Downtown Crossing in Boston, serving 13 stops/stations. Silver Line Waterfront operates from South Station to the South Boston waterfront, where it splits into two branches: SL1 to Logan International Airport and SL2 to Boston Marine Industrial Park. Including both branches, this section is 5.5 miles long and serves 16 stops/stations.

Silver Line stop at East Berkeley Street

Bus and Trackless Trolley

The MBTA operates 178 bus routes that serve metropolitan Boston. It also has three electric trackless trolley lines that operate in Cambridge,

MBTA BUS IN DOWNTOWN BOSTON NEAR THE OLD STATEHOUSE

Watertown, and Belmont. Nearly all bus routes connect with the rapid transit system. The bus/trackless trolley system includes crosstown service, feeder service to rapid transit stations, frequent service along major arterials in heavily congested areas, and express bus service. Most of these routes have lengthy histories, and many had their origins as streetcar lines built before 1900. Schedules and routings have been revised gradually over the years, but most continue to operate along the same general alignments, with minor modifications made in response to changing demand. Recently, the most heavily patronized bus routes have been formally designated as "Key Routes." The frequency of service on these routes is similar to rapid transit service frequencies, providing shorter wait times than are typical for bus service.

COMMUTER RAIL

The 365-mile commuter rail network is composed of 13 radial lines and 126 stations. The commuter rail system is split into two parts: North Side service operates out of North Station, and South Side service out of South Station. The Massachusetts Turnpike can be considered the dividing line: the routes north of the Turnpike—the Newburyport/Rockport, Haverhill, Lowell, and Fitchburg Lines—constitute the North Side. The lines along the Turnpike or to the south—the Framingham/Worcester, Needham, Franklin, Providence/Stoughton, Fairmount, Middleborough/Lakeville, and Kingston/Plymouth Lines, as well as the recently opened Greenbush Line—make up the South Side. There is no direct transit connection between North and South Stations, although a project to link the two has been proposed, and preliminary designs have been developed. Over 40,000 park-and-ride spaces are provided for commuter rail riders.

COMMUTER BOAT

The MBTA provides commuter boat service on four routes. These services are operated directly by the MBTA or through subsidized private contractors. The routes operate between:

- Hewitt's Cove (Hingham) and Rowes Wharf (Boston)
- Fore River Shipyard (Quincy), Long Wharf (Boston), and Logan Airport
- Point Pemberton (Hull), Long Wharf (Boston), and Logan Airport
- Charlestown Navy Yard and Long Wharf (Boston)

MBTA COMMUTER BOAT

Paratransit

The MBTA provides door-to-door paratransit service for customers with disabilities who cannot use the fixed-route system. This service, THE RIDE, is operated through private contractors using 228 lift-equipped vans and 225 sedans.

MBTA THE RIDE VEHICLE

DEMOGRAPHIC TRENDS

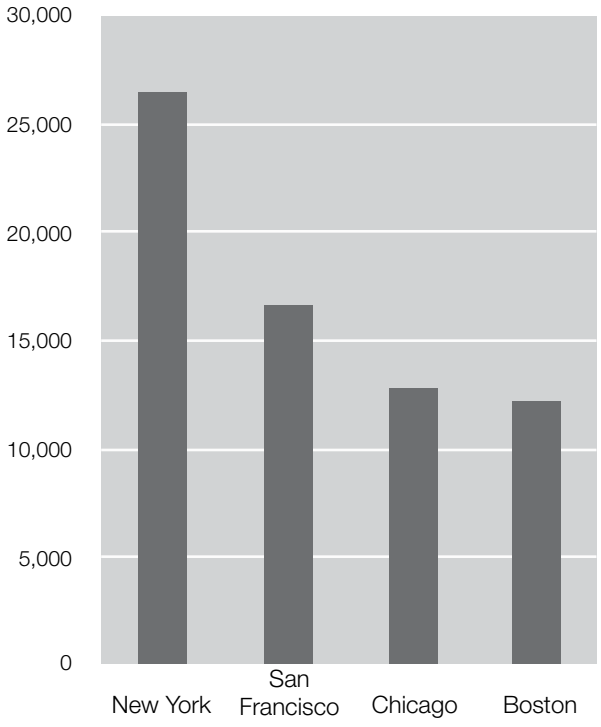
Population

The MBTA service area in Massachusetts consists of 175 diverse cities and towns across the eastern and central sections of the state. In 2000 the population of this area was 4,661,000, or about 73% of the total state population.[1] Including the cities in Rhode Island served by the Providence commuter trains adds another 266,000 residents, for a total service area population of 4,927,000. Densely populated communities located within Route 128 account for 40% of the population. In the Massachusetts service area, population is projected to increase by 18%, to 5,497,000, by 2030.[2]

Boston, with a 2000 population of 592,000, is the largest city in the service area, a position it should retain in 2030 with a forecasted population of 699,000. Due to the high concentration of jobs and other economic activity in Boston, its current population doubles in the daytime to approximately 1.2 million people. Thirteen percent of the residents in the MBTA's service area live in Boston, which has a population more than three times that of either of the next two largest cities served by the Authority: Providence, with 174,000 residents, or Worcester, with 173,000.[3]

Boston Proper has a population density of 12,166 people per square mile. Of major U.S. cities, only New York City, San Francisco, and Chicago have higher population densities (see Figure 4-1). The Boston metro region, while the fifth-largest in population of U.S. metropolitan areas, ranks 24th in terms of regional population density, with 2,200 people per square mile.[4]

FIGURE 4-1
2000 Population Density* Comparison
*(per square mile)



1 2000 U.S. Census.

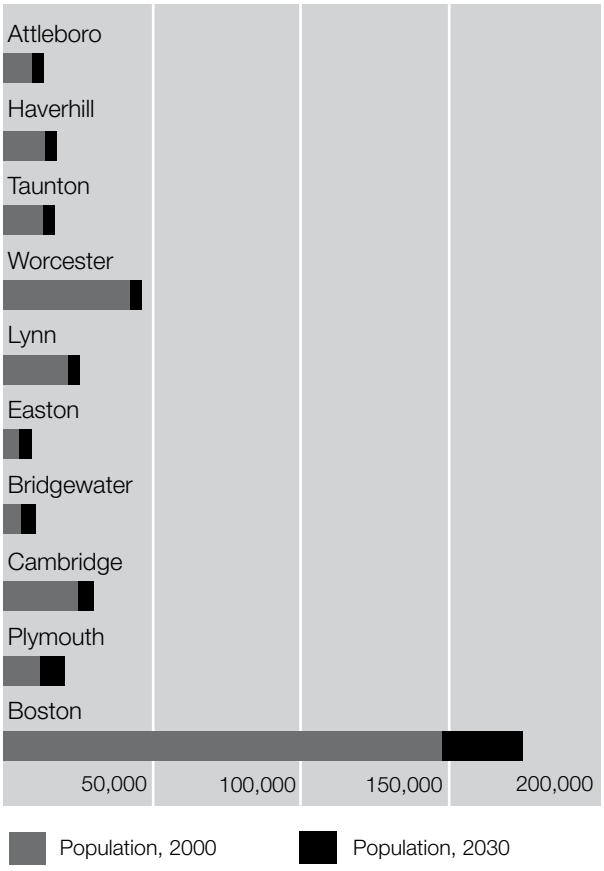
2 Metropolitan Area Planning Council (MAPC) and other regional planning agencies' population and employment forecasts.

3 Because Providence is not in the MBTA's service area, it does not appear in Figure 4-1.

4 Demographia World Urban Areas: Population & Density, 2008.

Between 2000 and 2030, population levels in many communities in the service area are projected to remain relatively stable. The 10 communities with the largest projected numerical population growth represent almost one-third of the region's population in both 2000 and 2030 (see Figure 4-2). Eight of these communities are directly served by MBTA commuter rail and/or rapid transit service.[5]

FIGURE 4-2
MBTA Region 2000–2030
Population Growth: Top-Ten Communities in Order of Population Increase



While more than one-third of the communities in the MBTA service area are projected to grow by 10% or less, the population of many of the exurban communities in the outer edges of the service area is expected to increase 50% or more by 2030. These communities include towns located along or near I-495, such as West Newbury, Tyngsborough, Upton, Easton, and Bridgewater.

Employment

About 2,543,000 people work in the MBTA's Massachusetts service area, representing about 80% of total state employment. About 45% of service area employment is concentrated in the cities generally within Route 128. A total of 560,000 jobs are estimated to be in Boston, making up 22% of total service area employment and about half the jobs within Route 128 (see Figure 4-3). This is five times the employment in Cambridge, the second-largest employment center in the service area.[6]

By 2030, employment in the MBTA service area is projected to have increased by 19% over the 2000 level. Growth patterns, however, are expected to vary throughout the service area. Much of the growth (43%) is projected to occur in just 10 communities, which alone accounted for over one-third (38%) of the state's employment in 2000. In almost half (45%) of the region's communities, employment is projected to stay the same or grow modestly over the next 25 years.[7]

Boston has become one of the top-ten tourist destination cities in the U.S., with 16.3 million visitors in 2004.[8] An estimated 721,000 overseas visitors come to Boston each year.

Boston is also a well-established international center for education; the Boston area boasts more than 100 colleges and universities. At institutions in Boston and Cambridge alone, there are more than 250,000 students.

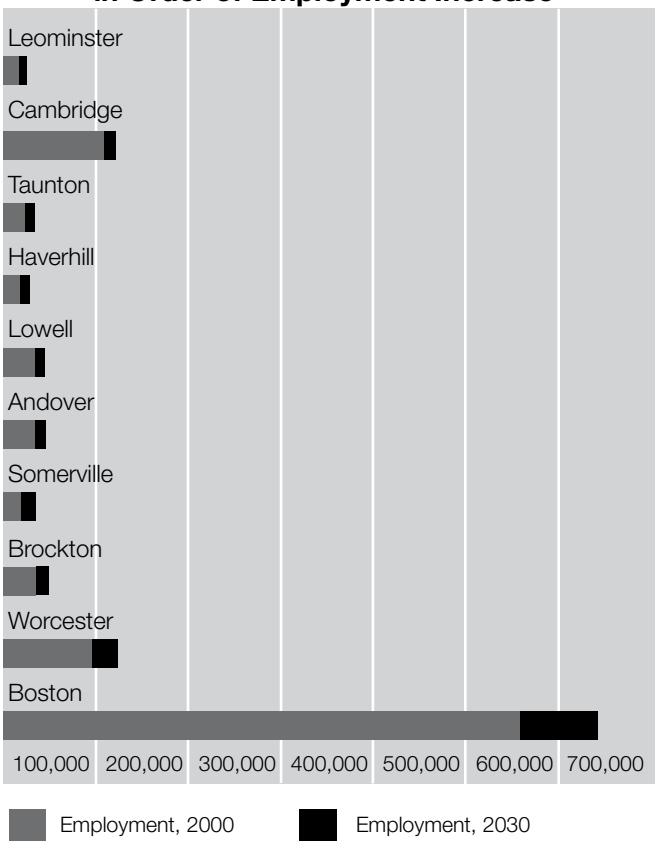
5 Ibid.

6 2000 U.S. Census.

7 Metropolitan Area Planning Council (MAPC) and other regional planning agencies' population and employment forecasts.

8 City-Data.com.

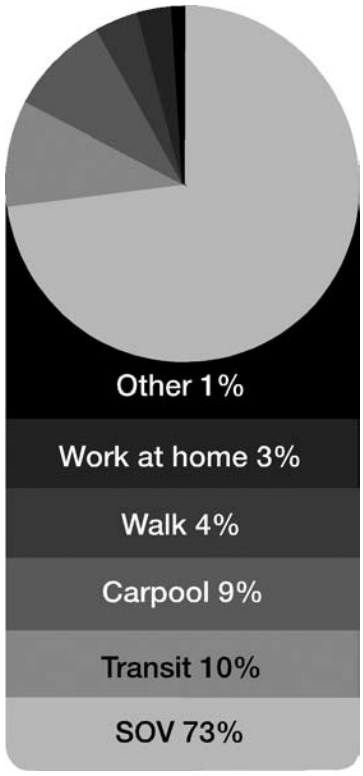
FIGURE 4-3
MBTA Region 2000–2030
Employment Growth: Top-Ten Communities in Order of Employment Increase



COMMUTING AND CONGESTION TRENDS

Nationally, work trips comprise a small proportion—15%—of all trips.[9] However, because most commuting occurs during peak travel times, work trips determine the capacity needs of highway and transit systems, as well as the degree to which the performance of these systems meets travel demand. Seventy-three percent of all work trips from municipalities in the MBTA service area were made in single-occupancy vehicles (SOVs) in 2000, and 10% were made by transit (see Figure 4-4). The transit mode share in Boston is more than twice the national average.[10] The transit share rises to 34% and the SOV share drops to 46% for work trips to Boston and Cambridge, home to about one-quarter of the employment in the service area (see Figure 4-5).[11]

FIGURE 4-4
2000 Travel Modes to Work by Boston Region Residents

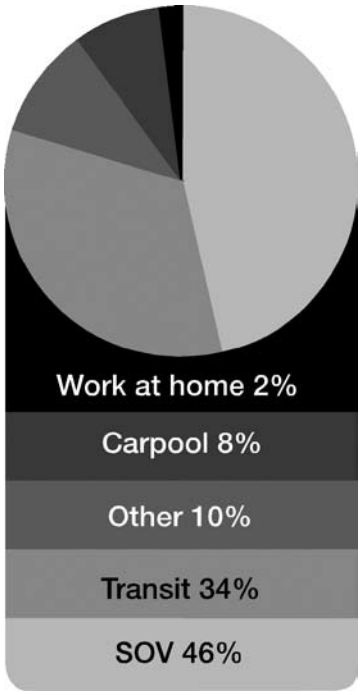


9 Transportation Research Board, *Commuting in America III: The Third National Report on Commuting Patterns and Trends*, NCHRP Report 550, October 2006, p. 3.

10 Ibid, p. xix.

11 2000 U.S. Census.

FIGURE 4-5
2000 Travel Modes to Work to Boston and Cambridge by Boston Region Residents



Boston has the 12th-worst traffic congestion in the country, according to the most recent Texas Transportation Institute Urban Mobility Report (2007). Because of traffic congestion, drivers in eastern Massachusetts annually spent 93 million hours stuck on congested roadways and wasted 62.5 million gallons of gasoline. The economic cost to regional commuters was estimated at $1.8 billion annually. The average Boston area commuter spent 46 hours a year in traffic jams, and, according to the Texas Transportation Institute, without public transit, the impact on the average commuter would translate into an additional 11 hours of traffic delay.

The regional model projects that, in 2030, vehicle miles of travel (VMT) will be 20% greater and average travel times 26% longer, compared to 2000, if current trends continue and no changes are made to the transportation system.

CHAPTER 5

Priorities for Achieving a State of Good Repair

To achieve a state of good repair (SGR), infrastructure assets must be replaced as safety standards or obsolescence dictates. Once a state of good repair has been achieved, the most effective way to sustain the optimum performance of these assets is preventive maintenance. Deferring maintenance, even for a short time, accelerates the degradation of infrastructure assets. Proper attention to maintenance can greatly extend useful life and reduce costs overall. In addition, proper maintenance is critical for providing safe and reliable service.

The key components of a successful, ongoing preventive maintenance program include adequate personnel and the tools, equipment, and materials necessary to complete maintenance tasks within a reasonable time frame. It is imperative that these resources be made available in order for the MBTA to maintain efficient and safe operations that meet the needs of the riding public.

The following discussion surveys the categories of the MBTA's infrastructure assets, describing the status of each and highlighting the most important capital investments that will need to be made during the time frame of this PMT to bring the system into SGR. A more comprehensive list of SGR needs can be found in Appendix H. In addition to the currently identified SGR projects, it is anticipated that prior to 2030 many capital assets presently in serviceable condition will reach end-of-life and require replacement.

REVENUE VEHICLES

Revenue vehicles are those vehicles that are used in the direct provision of services to the public. As such, they represent one of the most visible and important MBTA asset categories. The MBTA's revenue vehicles are currently as follows:

- 432 rapid transit vehicles serving the Red, Orange, and Blue Lines
- 207 light rail vehicles serving the Green Line
- 10 streetcars for the Mattapan High Speed Line
- 410 commuter rail passenger coaches
- 80 commuter rail locomotive units
- 968 motor bus coaches powered by compressed natural gas or low-sulfur diesel
- 20 compressed-natural-gas buses for the Silver Line
- 32 dual-mode buses for the Silver Line
- 28 electric trackless trolleys
- 426 RIDE vehicles
- 2 passenger marine vessels

The MBTA adheres to a general standard life cycle of 35 years for rapid transit and light rail vehicles, 25 years for commuter rail locomotives, 25 to 30 years for commuter rail coaches, and 15 years for buses. The condition of each vehicle fleet generally correlates with vehicle age; several of the older fleets are in need of major component replacements, overhauls, or, in some cases, total replacement. Without scheduled overhauls and planned retirements, the maintenance required to keep the existing fleets operating with acceptable service reliability would be excessively costly. Table 5-1 lists the MBTA's revenue vehicles by type and specific model and gives the remaining useful life of each.

It is anticipated that within the horizon of this PMT, the MBTA will need to replace the 74 No. 1 and 58 No. 2 Red Line cars. Beginning in 2013, the MBTA will start taking delivery of 146 new Orange Line cars to replace the current fleet of

MBTA personnel conducting tests on an Orange Line vehichle

120 No. 12 cars. Plans are currently underway to design the replacement Red and Orange Line cars in tandem. On the Blue Line, the MBTA is currently in the process of replacing the 70 No. 4 cars with 94 new No. 5 cars, which should still be in operation in 25 years. In addition, the MBTA has recently put 95 new No. 8 Green Line cars into service. As the existing fleet of 114 No. 7 Green Line cars is retired, additional new cars (No. 9) will need to be purchased.

The entire bus fleet will also turn over within the 25-year horizon of the PMT. The MBTA's current policy is that the average age of the buses in the fleet will not exceed 7.5 years. This average may be difficult to maintain as the current vehicles start to reach retirement age. Many of the buses in the existing fleet were purchased within a small window of time, so they will be due for replacement at approximately the same time.

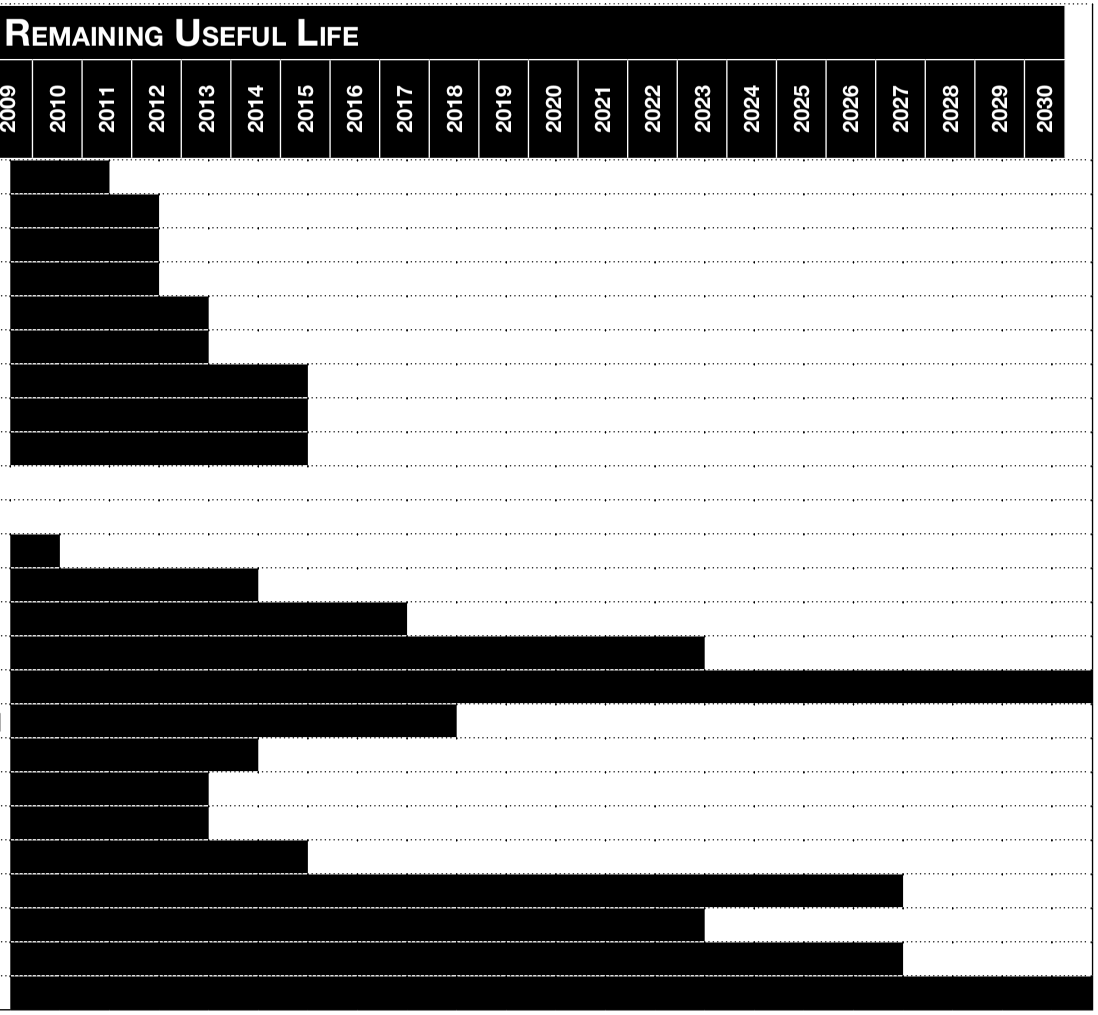
The MBTA is currently in the process of procuring 75 new bi-level commuter rail coaches, delivery of which should begin within the next five years. During the course of the next 25 years, all but the most recently purchased coaches will need to be replaced. In addition, the Authority is in the process of purchasing 28 new locomotives and will need to replace all other locomotives currently in service by 2030.

TABLE 5-1
Revenue Vehicle Fleet: Remaining Useful Life

Vehicle Type by Mode	Quantity	Date in Service	Asset	Remaining Useful Life
Bus				
Bus	5	1976	40' Trolley Bus 1976	
Bus	28	2003	Neoplan Electric Trolley Buses	
Bus	32	2004	Dual Mode Vehicle 2005	
Bus	17	2002	New Flyer 40' low-floor	
Bus	44	2003	2003 Neoplan 60' Artic. Bus	
Bus	124	2003	NABI 40' Bus	
Bus	175	2004	NABI 40' Low-Floor CNG	
Bus	148	1994	40' RTS Bus 1994	
Bus	60	1995	40' RTS Bus 1995	
Bus	84	2005	ECD Neoplan I	
Bus	109	2006	ECD Neoplan II	
Bus	155	2007	ECD New Flyer I	
Bus	155	2008	ECD New Flyer II	
Ferry	2	1996	Diesel Catamarans	
Rapid Transit				
Mattapan Line	10	1945	Presidential Conference Cars (PCCs)	
Green Line	94	1986	No. 7 Passenger Cars	
Green Line	20	1997	No. 7 Additional Passenger Cars	
Green Line	85	2005	No. 8 (Breda) Cars	
Green Line	10	2007	No. 8 (Breda) Additional Cars	
Blue Line	50	1979	No. 4 Passenger Cars I	
Blue Line	20	1979	No. 4 Passenger Cars II	
Blue Line	94	2008-09	Blue Line No. 5 Passenger Cars	
Orange Line	120	1981	No. 12 Passenger Cars	
Red Line	74	1969	No. 1 Passenger Cars	
Red Line	58	1988	No. 2 Passenger Cars	
Red Line	86	1994	No. 3 Passenger Cars	

TABLE 5-1 (cont.)
Revenue Vehicle Fleet: Remaining Useful Life

VEHICLE TYPE BY MODE	QUANTITY	DATE IN SERVICE	ASSET	REMAINING USEFUL LIFE
THE RIDE	11	2003	2003 Dodge Vans	
THE RIDE	11	2004	2003 Dodge Vans	
THE RIDE	68	2004	2003 Dodge Paratransit Vans	
THE RIDE	167	2004	2005 Ford Sedans	
THE RIDE	3	2006	2006 Ford Sedans	
THE RIDE	22	2006	2007 Ford Sedans	
THE RIDE	3	2008	2008 Ford Sedans	
THE RIDE	50	2007	2006 Ford Paratransit Vans	
THE RIDE	84	2007	2007 Ford Paratransit Vans	
Commuter Rail				
Locomotives	18	1979	Locomotive - F40PH-2	
Locomotives	25	1987	Locomotive - F40PH-2C	
Locomotives	12	1991	Locomotive - F40PHM-2C	
Locomotives	25	1997	Locomotive - GP40MC	
Locomotives	28	2011	Locomotive - New Diesel 2005	
Coaches	57	1979	Passenger Coach – Pullman Standard [BTC]	
Coaches	33	1987	Passenger Coach - MBB [BTC]	
Coaches	34	1987	Passenger Coach - MBB [CTC]	
Coaches	40	1987	Passenger Coach - Bombardier-A	
Coaches	106	1989	Passenger Coach - Bombardier-B	
Coaches	75	1990-91	Passenger Coach - Kawasaki	
Coaches	17	1998	Passenger Coach - Kawasaki-option	
Coaches	15	2002	Passenger Coach - New Bi-level	
Coaches	33	2005	Passenger Coach - Kawasaki - 2005	



NON-REVENUE VEHICLES

For use in responding to emergencies, performing maintenance work, keeping the system safe for passengers, and engaging in major construction work, the MBTA operates a large fleet of vehicles and work equipment not used to transport passengers. Non-revenue vehicles and equipment support the entire range of Authority operations, including maintenance service calls, safety-critical situations, field supervision, revenue collection, repair projects, and system upgrade efforts, all of which occur throughout the MBTA's service district.

The Authority owns a fleet of over 1,000 non-revenue vehicles. These vehicles are of many different types, including rail-mounted cars, rubber-tired cars, trucks, sedans, police cruisers, snow plows, track geometry cars, brush cutters, and spreaders. Included in the maintenance-of-way category are crane, bucket, cable, platform, and snow-fighting trucks.

In general, the useful life expectancy for non-revenue equipment is approximately 10 years, although this varies with the type of equipment. Given this 10-year replacement cycle, most assets in this category will be due for replacement either once or twice during the next 25 years.

TRACK/RIGHT-OF-WAY

Achieving and maintaining a state of good repair for rapid transit and commuter rail track and right-of-way is critical to the on-time performance and safety of the system, as it reduces the need for speed restrictions and the possibility of accidents.

Rapid Transit

The MBTA currently operates light and heavy rail transit over 185 miles of track, 125 of which are in revenue service on the Red, Orange, Blue, and Green Lines. Of the 185 miles of rapid transit track, 180 miles are 115 lb. rail, and 5 miles are 85 lb. rail. In general, track has a useful life of 25 years.

The rapid transit right-of-way generally consists of track, ballast, and concrete or timber ties; however, there are about 14 miles of direct-fixation track. The subway fleets operate over approximately 1 million feet of mainline-ballasted track and approximately 400,000 feet of yard-ballasted track. There are 383,000 wood ties in the track system and 60,000 concrete ties, of which 50,400 are monoblock ties and approximately 2,500 dual block ties. Special trackwork consists of 619 switches for turnouts and crossovers, both revenue and non-revenue. Each rapid transit line is divided into segments that are determined by their geographical location or track construction.

The MBTA has approximately 560 mainline turnouts (with equipment), which have useful lives ranging from 4 to 25 years. There are 675 total yard turnouts (with equipment), which have useful lives ranging from 8 to 25 years. In addition, there are 64 grade crossings along the Green Line and other crossings within MBTA yards that generally have a useful life of 12 to 15 years.

The several different types of track construction used on each line of the rapid transit system are listed in Table 5-2.

The MBTA has an ongoing track and tie replacement program. In addition, recent track efforts have focused on upgrading the Green Line tracks to ensure proper operation of the new low-floor cars. The Green Line tracks will require continuous inspection and maintenance to support this new fleet.

Other anticipated high-priority projects include replacement of the floating slab track on the Red Line between Harvard and Alewife Stations. This track has been in use since 1984 and is reaching the end of its useful life. The concrete dual-block ties on the southern portion of the Orange Line currently need monitoring and may require rehabilitation in the near term. On the Blue Line, sections that are currently bolted rail should be replaced with welded rail to maintain the system. In addition, the track yards need to be upgraded.

TABLE 5-2
Rapid Transit Track

Line	Miles of Revenue Track	Types of Track Construction
Red Line	45	Timber tie track Concrete dual-block tie track Direct-fixation Concrete floating slab track The entire line is powered by third rail.
Orange Line	22	Timber tie track Concrete dual-block tie track Direct-fixation Concrete floating slab track The entire line is powered by third rail.
Blue Line	12	Primarily timber tie Some sections are monoblock concrete tie track. The line is powered by third rail and overhead catenary lines.
Green Line	46	Primarily wood tie and ballast units Some monoblock concrete tie track The running rail on the line consists of both “T” rail and girder guardrail. The entire line is powered by overhead catenary.

Commuter Rail

Commuter rail right-of-way consists of rail, wooden ties, railroad crossties, grade crossings, and associated fencing. Most of the over 1,300 miles of rail (650 miles of track) in the commuter rail network consists of welded rail, although sections of older bolted rail remain along the Haverhill, Lowell, and Fitchburg Lines. Sections of straight rail can generally be expected to last approximately 40 years, while curve rail has a shorter life span.

Approximately 1.5 million timber cross ties and switch timbers support the commuter rail system. Railroad crossties usually have a life span of 25 to 30 years. Grade crossings are the most prominent fixtures of the commuter rail system. The system has 257 grade crossings, which have a life expectancy of 12 years.

The MBTA has an ongoing rail replacement program for the commuter rail system to maintain SGR. In addition to the rail itself, approximately 48,000 crossties, 5,000 switch timbers, and 21 grade crossings are replaced each year through this program.

SIGNALS

Train control is an integral part of rail operations, as it is vital to the safety and reliability of the system. Signals are necessary for collision avoidance, route integrity, speed control and enforcement, broken rail protection, and all other safety aspects of rail operations.

Rapid Transit

The rapid transit system uses several types of signal system architecture on the four rapid transit lines. The Red and Orange Lines use an Automatic Train Control (ATC) system. This type of signal system consists of both wayside equipment and a car-borne package that receives commands from the wayside circuitry. The Blue and Green Lines utilize an Absolute Block Signal (ABS) system. In this case, the signal equipment is housed in wayside cases and Central Instrument Houses but does not communicate with an on-board package. Each track circuit is governed by a signal that will, depending on the position of the train, restrict the movement of the following train. On the Blue Line, train stops provide an additional safety feature to ensure that a train comes to a stop when a signal is red. Much of the Green Line operates in the same way, except that there are no train stops at the signals: the operator has sole responsibility for adhering to the signals. Train signals are not used on the parts of the Green Line that operate in vehicular traffic.

The signal system also includes supervisory controls. These are located in the rapid transit Operations Control Center (OCC) and allow control of field devices, i.e., switches, signals, heaters, etc., from a centralized location. The supervisory control system facilitates more consistent and timely revenue service and reduces the number of required field personnel.

TABLE 5-3
Rapid Transit Signal System Components

Component	Red Line	Orange Line	Blue Line	Green Line	Total
Signals	210	199	154	497	1,060
Switches	135	107	86	91	419
Switch heaters	68	101	43	40	252
Track circuits	355	245	181	497	1,278
Third-rail heaters	1,632	457	12		2,101
Train stops	2	17	145		164
Train stop heaters	2	34			36
Trip stops			145		145
Trip stop heaters			290		290
Train approach lights	12	48	74		134
Instrument houses	16	12	4		32

Many of the components of the rapid transit signal systems are listed in the table below, which gives their distribution among the lines.

The signal system on the Orange Line has recently been upgraded; however, signal work on the other rapid transit lines remains a high priority. On the Red Line, the failure rate of the signal equipment has increased over the years in several areas due to outdated equipment or inadequate maintenance. The signals in the Green Line central tunnel, which date from the 1920s and are the oldest of their kind in regular use in the U.S., must be replaced. The Blue Line ABS signal system, although relatively new, is not considered state of the art and does not allow for as much flexibility in scheduling as newer signal technologies. Consideration should be given to upgrading the system to allow for implementation of shorter headways.

Commuter Rail

The Authority's commuter rail signal system consists of over 480 miles of signalized track, 190 miles of aerial pole line, 80 interlockings, 10 train control machines, over 1,000 signal heads, 476 electric switches, and 200 grade crossings with automatic protection equipment. There are 35 bungalows and 52 bungalow/houses in the commuter rail signal system. They all have a useful life of 25 years. The two systemwide signal units are the wayside system and the OCC signal equipment. Both systems have a 25-year useful life.

Annual replacement of underground signal cable, aerial signal cable, electric switch machines, and electric grade crossing mechanisms is required to ensure the safety and reliability of the signal system within an acceptable life-cycle cost. Signal maintenance is performed under the commuter rail management contract and is primarily funded by the operating budget.

COMMUNICATIONS

The MBTA communications system comprises a two-way radio system, telecommunications, security systems, closed circuit television systems, remote monitoring and control systems, fire alarm systems, electronic signs, public address systems, the MBTA website, and the customer-care center. These are connected via a Wide Area Network (WAN) of interconnected fiber optic cables and leased circuits to transmit voice, data, and video communications between electronic devices throughout the Authority's service district.

MBTA Bus Operations Center

Many of these systems communicate through the OCCs. The rapid transit OCC is one of the most automated transit control centers in the world. It consists of proven state-of-the-art computer-based technology that permits real-time monitoring and supervisory control of the signal and communication systems for all four transit lines. The bus OCC provides real-time route performance monitoring and dispatch through the use of CAD/AVL (computer-aided dispatch/automated vehicle locator) equipment. The commuter rail OCC provides real-time monitoring and supervisory control of the signal and communications systems for the commuter rail network.

The MBTA uses the Supervisory Control and Data Acquisition System (SCADA II) to remotely monitor and control miscellaneous equipment owned and operated by the Authority at various locations, including fire alarms, water pumps, emergency ventilation fans, emergency generators, and secured doors.

The Authority has made great strides over the past several years in upgrading its communications systems so as to monitor and operate its services more efficiently and to communicate with the public more effectively. Over the next 25 years, the MBTA will need to complete the efforts that it has started and track trends in rapidly changing technologies to keep its communications systems up-to-date.

POWER

Using power supplied by an outside utility, the MBTA transforms and distributes electricity over its own system to power a network that consists of 10 power substations, 67 unit substations, 48 traction power substations, 3 switching stations, 800 miles of cable, 1,200 circuit breakers, 1,000 switch boxes, 3,325 manholes, 54 passenger station low-voltage switchgears, 2 emergency backup generators, and 2 supervisory control systems to monitor and control all of the power facilities.

For the rapid transit and trackless trolley services, the MBTA distributes electricity to power various systems, including: signals; communications; station lighting, escalators, and elevators; maintenance and layover facilities; tunnel lighting and ventilation fans; fire alarms; and fare collection. In addition, the MBTA distributes electricity to the overhead catenary system that powers the Green Line, part of the Blue Line, the Silver Line Waterfront, and the trackless trolleys. The third-rail system that powers the Red Line, Orange Line, and part of the Blue Line also receives electricity through the MBTA's power network. In addition, the MBTA distributes the power to light five ferry facilities.

The commuter rail electrical system provides lighting and power for signal systems, communication systems, bridges, buildings, stations, parking lots, maintenance facilities, layover facilities, and grade crossings. This system also provides redundant power at critical facilities and, via cables, power to operate mechanisms on the Beverly Drawbridge. Again, the MBTA itself distributes the electricity carried by this system.

The major components of the power system have a useful life of between 15 and 30 years, meaning that most will need to be replaced during the period of this PMT in order for the system to be maintained in SGR. The most critical needs include replacing the cables throughout the power system.

MAINTENANCE FACILITIES

Maintenance facilities are where the MBTA conducts regularly scheduled maintenance and emergency repairs on its vehicle fleets. Basic structures at each of these facilities include roofs, electrical systems, and major maintenance equipment such as lifts and hoists.

The Authority operates three heavy rail maintenance facilities: Cabot (Red Line), Wellington (Orange Line), and Orient Heights (Blue Line). The four light rail maintenance facilities are located at Riverside, Reservoir, and Lake Street (for the Green Line) and at Mattapan Yard (for the Mattapan High Speed Line).

The nine maintenance facilities for the bus and trackless trolley system are listed in Table 5-4. The MBTA also operates the Everett Central Repair Facility at which it completes heavy maintenance for the entire bus fleet as well as equipment overhauls for light and heavy rail equipment.

TABLE 5-4
Bus Maintenance Facilities

Facility	Year Built	Vehicle Capacity
Fellsway	1925	61
Quincy	1930	88
Lynn	1936	104
Albany	1941	130
Cabot	1975	190
North Cambridge (trackless trolley)	1978	32
Charlestown	1979	242
Arborway	2004	118
Southampton	2004	76

For commuter rail, the MBTA operates a maintenance facility at the Boston Engine Terminal, a service and inspection facility at Widett Circle, a storage and light inspection facility at Readville, and outlying layover facilities.

The MBTA's maintenance facilities also include 17 smaller ones, some of which are in structures or buildings used by the Authority for various tasks and purposes.

As can be seen in Table 5-4, one of the bus garages (Fellsway) is over 80 years old, and two (Quincy and Lynn) are over 70. MBTA plans anticipate closure of Fellsway and construction of a replacement North Side facility that could ease system capacity constraints at Lynn and Charlestown. Quincy Garage also needs to be rehabilitated, as do Charlestown and Cabot. In addition, current needs include the design and construction of a new bus facility at the Arborway and the retrofit of existing bus facilities to service compressed-natural-gas (CNG) vehicles.

A number of challenges are inherent in keeping facilities up-to-date. As new fleets are purchased, they bring with them ever-changing technologies that require different types of maintenance to keep the vehicles on the road. The purchase of CNG vehicles provides a pertinent illustration. To maintain this fleet, it was necessary to build a new maintenance facility and retrofit existing ones. In addition to the equipment housed in the maintenance facilities, the buildings themselves need ongoing attention, including roof replacements, plumbing upgrades, general repairs to offices and other employee areas, etc.

STATIONS

Stations are composed of the basic structure, including roofs and platforms, etc., as well as the equipment inside of the buildings, such as lights, elevators, and escalators. The MBTA system has over 250 stations. This includes 124 rapid transit and light rail stations, six of which serve more than one line (North Station, Haymarket, State Street, Government Center, Park Street, and Downtown Crossing). Subway stations typically have a useful life of 50 years. The MBTA also has 134 commuter rail stations including North Station, out of which the five North Side commuter rail lines operate, and South Station, out of which the eight South Side commuter rail lines operate. The Silver Line Washington Street bus rapid transit (BRT) line has 17 stations, and the MBTA owns 160 stops that are distributed throughout the bus system. Several rapid transit stations—Harvard Square, Ruggles, Ashmont, Haymarket, and Forest Hills—are also major bus terminals. Dudley is the only major station facility that serves bus and BRT, but not rapid transit.

Extensive station renovation work is currently being completed on the Red and Blue Lines. Red Line stations in Dorchester and the Red Line component of South Station are undergoing complete reconstruction. Eight Blue Line stations are being modernized to accommodate six-car trains and to make them fully accessible through the installation of new elevators and entrances. Over the past several years, the MBTA has implemented a program to improve elevator and escalator operability, in order to make stations more accessible to all customers. As a result of the rigorous inspections, maintenance, and repairs undertaken under this program, elevator and escalator operability and reliability have improved dramatically. The MBTA will continue

Escalator in Red Line station

to prioritize elevator and escalator state of good repair for the future.

Although most of the station structures will outlast the horizon of this PMT, many station components will need to be replaced or repaired during the next 25 years. For example, roof replacements are anticipated at Roxbury Crossing, Jackson Square, Mass. Avenue, and Forest Hills Stations. In addition, ventilation, platform, pavement, and drainage repairs will be necessary at stations throughout the system. The work needed to bring other stations into SGR, e.g., Boylston Station, will be undertaken in the context of the accessibility program, which is discussed in Chapter 6.

Also of importance in maintaining the aesthetics of stations and promoting ease of customer use is the continuous replacement of outdated signage. This station update process, which is currently underway through initiatives such as the wayfinding program, will be continued throughout the period of this PMT.

FACILITIES

MBTA "facilities" encompass a wide variety of structures, including administrative buildings, operators' lobbies, ferry terminals, vent buildings, storage buildings, noise walls, tunnels, culverts, retaining walls, parking garages, parking lots, escalators and elevators, ventilation structures, and the fencing necessary to prevent trespassers from gaining access to tracks carrying fast-moving trains. MBTA-owned administrative buildings include 45 High Street, 500 Arborway, Charlestown (Buildings 2 and 3), the Cobble Hill commuter rail operations facility, the Quality Control Facility on Freeport Street, and the MBTA Police Headquarters on Southampton Street, plus various others located throughout the rapid transit and commuter rail systems.

Commuter rail facilities include all structures or facilities at the 12 outlying layover points. Located at or near the end of commuter rail lines, layover areas are where trains are stored and serviced overnight. Repair equipment and facilities are located here to service and clean the

MBTA BUS-WASHING FACILITY

trains, prevent cold weather damage, perform maintenance, and eliminate idling. The MBTA also owns several commuter rail maintenance facilities, including Readville Mechanical, Readville maintenance of way (MOW), Abington MOW, Wilmington MOW, and Roland Street MOW. In addition, the Authority owns commuter rail equipment storage facilities at Lowell, Attleboro, Franklin, Rockport, and Wilmington.

The MBTA has recently made much progress bringing station elevators and escalators into SGR and maintaining them at a high level of reliability for customers with limited mobility. Going forward, emergency repairs are needed for many facility structures and components throughout the system. For example, MBTA parking garages are in serious need of work, and repairs are needed to stop leaks in many of the Authority's rapid transit tunnels. In addition, significant improvements are needed to the bathrooms and other facilities that are provided for the use of the front line employees who operate and repair the buses and trains.

BRIDGES

The MBTA owns and maintains 470 bridges systemwide, including 290 commuter rail, 57 rapid transit, 82 highway bridges that pass over MBTA

tracks, and 41 pedestrian bridges that also cross over MBTA tracks. The Authority also owns and maintains 610 culverts on various commuter rail lines. Railroad and transit bridges typically have a useful life of 70 years, while highway and pedestrian bridges have a useful life of 50 years. Many of the bridges owned and/or maintained by the MBTA are reaching or have attained their life expectancies. While many of these bridges are in good structural condition, others are anticipated to need repairs.

The MBTA has an ongoing inspection program that is used to rate the condition of each bridge. The Authority prioritizes bridge replacement/reconstruction needs based on these ratings as well as a variety of factors including age, safety implications, service impacts, and the potential to disrupt service. Throughout the system, there are several highway bridges that are anticipated for future repair or replacement because of their age and condition.

Major rehabilitation projects are currently underway or are funded for the Merrimack River bridge on the Haverhill Line, the Concord Main Street bridge on the Fitchburg Line, the drawbridge over the Charles River that is used by all North Side commuter rail lines, the Fairmount Line bridges, the Beverly/Salem drawbridge, and Green Line bridges.

A number of MBTA railroad bridges will be a priority for future replacement and rehabilitation to improve the long-term structural integrity of the bridges, including West Street (Needham Junction), Washington Street (Somerville), the Gloucester drawbridge, and the Shawsheen River bridges. In addition, several rapid transit bridges have been identified as future candidates for rehabilitation, including the Savin Hill Underpass.

TECHNOLOGY

The MBTA has recently invested in many new technologies to improve the reliability, comfort, and convenience of its services. These include variable-message signs, automated stop announcements, automated-fare-collection equipment, and computer-aided dispatch/automatic vehicle locators (CAD/AVL). Although this equipment is state of the art now, the MBTA will need to track technology trends closely and react rapidly to keep this equipment up-to-date and in SGR. It is anticipated that the MBTA will replace much of its current technology during the next 25 years.

Variable-message sign in MBTA station

CHAPTER 6

Opportunities for System Enhancement and Expansion

Chapter 5 discussed many of the projects that would be needed to bring the MBTA infrastructure into a state of good repair. This chapter presents a wide array of enhancement and expansion projects that have been proposed, considered, or seriously mentioned in the course of the PMT planning process and that could be implemented over the next 25 years to meet the transit mobility needs of the region. The first section presents projects that are not specific to any of the geographic corridors defined for the PMT, but have systemwide impacts. In the following sections, potential investments that primarily affect one corridor are organized and presented by corridor so they can be related to specific mobility challenges.

SYSTEMWIDE PROJECTS

This section discusses the identified mobility challenges that demand systemwide solutions. Some of the problems presented here apply equally across all corridors and are only discussed in this section. However, other systemwide problems are discussed here conceptually, but are also associated with more specific proposals that are discussed in the context of one or more corridors.

Energy and Technology

Adopt Clean-Fuel and -Vehicle Technologies

The MBTA has made great progress toward improving the emissions profile of its bus fleet through the purchase of compressed-natural-gas and clean-diesel vehicles. The Authority will track new advances in clean fuels and vehicles and will continue to incorporate them into the bus fleet as it turns

over. The MBTA will also acquire the equipment necessary to monitor and maintain the bus fleet to ensure that it functions at peak performance and does not emit more than the allowable amount of air pollutants, including CO_2.

CNG BUS

In addition, the MBTA envisions future electrification of the commuter rail system. This would benefit the region and the riding public by eliminating locomotive emissions, improving service reliability, and enhancing performance through more rapid acceleration and deceleration. However, full electrification would represent a revolution in the way that the MBTA operates the commuter rail system and would require phased construction and substantial capital investment over a long period of time. Over 500 miles of track would need to be electrified and a new fleet of locomotives purchased. While electrifying the system, the MBTA would have to own and maintain a mixed fleet of locomotives—diesel and electric—and would face significant scheduling and operational challenges, as regular service would need to continue without interruption. The total cost of infrastructure and equipment, coupled with the associated costs of maintenance and operational disruptions, makes electrification a multibillion-dollar project.

The groundwork for electrification was begun when the Providence Line was electrified to accommodate Acela high-speed service to New York and the mid-Atlantic states. As a result, systemwide electrification could begin with the use of electric locomotives for Providence service. Consideration is also being given to the possibility of electrification as a technology option for the proposed South Coast Rail extension.

Reduce Energy Consumption at Agency Buildings

In April 2007, Governor Deval Patrick issued Executive Order #484 requiring all Commonwealth agencies to meet the following targets:

- Reduce greenhouse gas emissions that result from state government operations by 25% below 2002 levels by SFY 2012, 40% by 2020, and 80% by 2050
- Reduce overall energy consumption at state buildings by 20% below 2004 levels by SFY 2012 and 35% by 2020
- Procure 15% of agency annual electricity consumption from renewable sources by 2012 and 30% by 2020
- Use BioHeat products with a minimum blend of 3% bio-based materials for all heating applications that use #2 fuel, starting with the winter of 2007-2008, and 10% BioHeat blend by 2012
- Meet the Massachusetts LEED Plus green-building standard for all new construction and major renovations
- Reduce potable water use 10% by 2012 and 15% by 2020, compared to 2006

To begin this effort, the MBTA must implement a monitoring system that will allow the Authority to measure energy consumption at individual facilities so that the appropriate strategies can be developed to meet the Governor's targets. Also of importance will be developing an organizational structure that will have the authority to manage and execute agencywide energy and CO_2 reduction programs.

Implement New Technologies and Supporting Policies

New technologies have allowed the MBTA to automate many systems and to collect data that can be used to improve services. The Authority will continue to implement intelligent transportation systems (ITS) and other technologies that are currently in place and will actively look to improve and enhance them. Technologies that the MBTA may pursue to improve service reliability, customer communication and convenience, and system safety/security include:

- Purchasing and deploying automatic passenger counters systemwide to improve timely collection of passenger load data
- Expanding existing capabilities and investing in new technologies that aid in continuous vehicle location and dispatch to improve on-time performance

MBTA subway Operations Control Center

- Installing and maintaining next-train alert systems at all rapid transit and commuter rail stations and ensuring the functionality of existing equipment
- Investing in and regularly updating a robust Web and mobile-phone trip-planning system with real-time schedule and on-time performance functionality for all modes
- Providing access to real-time translation services at all MBTA points of contact
- Installing and maintaining next-bus alert systems at Key Route bus stops that have more than 100 boardings per day
- Regularly updating and improving automated fare-collection (AFC) capabilities, including expansion to commuter rail and parking facilities
- Maintaining existing security systems and upgrading/expanding them as technologies and needs change
- Maintaining redundant and secure computer networks
- Investing in systems necessary to protect customer security when making online pass purchases
- Investing in sufficient bus simulation equipment to train new operators and re-train veteran operators on a regular basis
- Implement positive-train-control systems on the Green Line and all commuter rail lines.

Although the use of technology can greatly enhance system performance, some low-tech solutions and policy initiatives might also prove effective for ensuring continued improvement in meeting customer expectations. Some examples that could be evaluated include:

- Ensuring sufficient staffing for field inspections to assist in service monitoring
- Working with the cities/towns to provide signal priority for surface services (bus and Green Line) and bus queue jumps
- Implementing a proof-of-payment system and opening all doors to allow more rapid boarding (Green Line surface and commuter rail)
- Working with the cities/towns and passengers to consolidate bus stops

- Working with other Regional Transit Agencies (RTAs) in eastern Massachusetts to apply consistent service standards, coordinate schedules, integrate fare media/collection with customer information systems, and install information technology (IT) infrastructure necessary for implementation
- Revising the MBTA's recently defined Key Route service standard to increase the minimum frequency of service during off-peak times and to extend the span of service to begin earlier and end later
- Providing customer amenities systemwide, including bus shelters at all stops, heated waiting areas at stations that are open to the elements, bicycle racks (on all vehicles and at all stations), and functional air conditioning and heating on all vehicles
- Creating customer information centers at all bus transfer points/activity hubs and regularly updating posted schedules for the relevant routes. Making current schedules available for customer pickup on all buses

CUSTOMER SERVICE INFORMATION DISPLAY CASE

- Providing integrated signage at all MBTA transfer points
- Regularly updating neighborhood and bus-connection maps and network diagrams, and replacing the outdated ones at every station entrance/exit
- Installing safety signage systemwide that has been translated into international symbols
- Implementing oral and written translations in accordance with the MBTA's Limited English Proficiency policy, including displaying translated signage in all stations
- Regularly updating posted schedules and making current schedules available for customer pickup at newly created customer information centers in all stations
- Consolidating existing routes in high-frequency service corridors, and provide limited-stop service on the new, consolidated routes

Americans with Disabilities Act (ADA)–Compliant System Accessibility

The MBTA is now implementing accessibility programs throughout the transit system. Some of the more extensive station reconstruction projects are nearing completion, including the Key Station Program. A few are currently in project development, such as Hynes, Auburndale, Science Park, and Wollaston Stations. Completion of the accessibility program within this PMT cycle is a high priority for the MBTA. It is also important to recognize that in almost all instances, the implementation of required accessibility features results in an improved transportation system for all users.

As discussed in Chapter 1, the MBTA entered into an agreement in 2007 with the Boston Center for Independent Living (BCIL) to improve accessibility to all MBTA services for persons with disabilities. A key requirement of the agreement is elimination of separate treatment of persons with disabilities. At a number of stations

the MBTA has implemented the use of mini-high platforms or mobile lifts as an interim strategy to provide accessibility while plans for full system accessibility—and elimination of separate treatment—are developed and executed. Table 6-1 shows the status of station accessibility by line.

Passenger entering Green Line train via mobile lift

TABLE 6-1
Station Accessibility Status by Line

Line	All Stations	Number Accessible
Red Line	22	21
Orange Line	19	19
Blue Line	12	8
Green Line subway	13	5
Green Line surface	53	21
Mattapan Line	8	7
Silver Line Waterfront subway	3	3
Commuter Rail (all lines)	136	96
Total	***266***	***180***

As its first step toward implementing programs to meet ADA requirements, the MBTA designated 84 Key Stations that were considered the highest priority for accessibility improvements. Table 6-2 shows the current accessibility status of those stations by line.

TABLE 6-2
Key Station Accessibility Status

Line	Key Stations	Number Accessible
Red Line	12	12
Orange Line	11	11
Blue Line	6	4
Green Line subway	8	4
Green Line surface	19	19
Mattapan Line	2	2
Commuter Rail (all lines)	22	22
Total	***80***	***74***

The following table lists the stations that have yet to be made accessible and prioritizes them based on the accessibility evaluation criteria discussed in Chapter 3.

TABLE 6-3
Station Accessibility Enhancement Priorities

Station	Mode	Line	Corridor	Priority
Babcock Street	Rapid Transit	Green B	West	High
Blandford Street	Rapid Transit	Green B	West	High
Boylston	Rapid Transit	Green	Boston Proper	High
BU West	Rapid Transit	Green B	West	High
Chelsea	Commuter Rail	Newburyport/ Rockport	Northeast	High
Franklin/Dean College	Commuter Rail	Franklin	Southwest	High
Government Center*	Rapid Transit	Blue Line	Boston Proper	High
Government Center*	Rapid Transit	Green	Boston Proper	High
Hynes	Rapid Transit	Green	Boston Proper	High
Newton Highlands	Rapid Transit	Green D	West	High
Packard's Corner	Rapid Transit	Green B	West	High
Pleasant Street	Rapid Transit	Green B	West	High
Science Park*	Rapid Transit	Green	West	High
St. Paul Street	Rapid Transit	Green B	West	High
Symphony*	Rapid Transit	Green E	Boston Proper	High
Wollaston*	Rapid Transit	Red Line	Southeast	High
Allston Street	Rapid Transit	Green B	West	Medium
Auburndale*	Commuter Rail	Framingham/ Worcester	West	Medium
Back of the Hill	Rapid Transit	Green E	West	Medium
Beaconsfield	Rapid Transit	Green D	West	Medium
Belmont	Commuter Rail	Fitchburg	Northwest	Medium
Central Avenue	Rapid Transit	Mattapan	Southeast	Medium
Chestnut Hill	Rapid Transit	Green D	West	Medium
Chestnut Hill Avenue	Rapid Transit	Green B	West	Medium
Chiswick Road	Rapid Transit	Green B	West	Medium
Eliot	Rapid Transit	Green D	West	Medium
Englewood Avenue	Rapid Transit	Green C	West	Medium
Fairbanks	Rapid Transit	Green C	West	Medium
Griggs Street/Long Avenue	Rapid Transit	Green B	West	Medium
Kent Street	Rapid Transit	Green C	West	Medium
Natick	Commuter Rail	Framingham/ Worcester	West	Medium
Newtonville	Commuter Rail	Framingham/ Worcester	West	Medium
Riverway	Rapid Transit	Green E	West	Medium

*Station accessibility currently in planning or design.

TABLE 6-3 (cont.)
Station Accessibility Enhancement Priorities

Station	Mode	Line	Corridor	Priority
Sharon*	Commuter Rail	Providence/ Stoughton	Southwest	Medium
St. Paul Street	Rapid Transit	Green C	West	Medium
Summit Avenue	Rapid Transit	Green C	West	Medium
Sutherland Street	Rapid Transit	Green B	West	Medium
Tappan Street	Rapid Transit	Green C	West	Medium
Wakefield	Commuter Rail	Haverhill	North	Medium
Walpole	Commuter Rail	Franklin	Southwest	Medium
Warren Street	Rapid Transit	Green B	West	Medium
Wellesley Farms	Commuter Rail	Framingham/ Worcester	West	Medium
Wellesley Hills	Commuter Rail	Framingham/ Worcester	West	Medium
Wellesley Square	Commuter Rail	Framingham/ Worcester	West	Medium
West Medford	Commuter Rail	Lowell	North	Medium
West Newton	Commuter Rail	Framingham/ Worcester	West	Medium
Winchester Center	Commuter Rail	Lowell	North	Medium
Windsor Gardens	Commuter Rail	Franklin	Southwest	Medium
Ayer	Commuter Rail	Fitchburg	Northwest	Low
Brandon Hall	Rapid Transit	Green C	West	Low
Butler Street	Rapid Transit	Mattapan	Southeast	Low
Cedar Grove	Rapid Transit	Mattapan	Southeast	Low
Concord	Commuter Rail	Fitchburg	Northwest	Low
Dean Road	Rapid Transit	Green C	West	Low
Endicott	Commuter Rail	Franklin	Southwest	Low
Fenwood Road	Rapid Transit	Green E	West	Low
Greenwood	Commuter Rail	Haverhill	North	Low
Hastings	Commuter Rail	Fitchburg	Northwest	Low
Hawes Street	Rapid Transit	Green C	West	Low
Islington	Commuter Rail	Franklin	Southwest	Low
Kendal Green	Commuter Rail	Fitchburg	Northwest	Low
Lincoln	Commuter Rail	Fitchburg	Northwest	Low
Melrose Cedar Park	Commuter Rail	Haverhill	North	Low
North Wilmington	Commuter Rail	Haverhill	North	Low

*Station accessibility currently in planning or design.

TABLE 6-3 (cont.)
Station Accessibility Enhancement Priorities

Station	Mode	Line	Corridor	Priority
Parker Hill	Rapid Transit	Green E	West	Low
Plimptonville	Commuter Rail	Franklin	Southwest	Low**
Prides Crossing	Commuter Rail	Newburyport/ Rockport	Northeast	Low**
Riverworks	Commuter Rail	Newburyport/ Rockport	Northeast	Low**
Shirley	Commuter Rail	Fitchburg	Northwest	Low
Silver Hill	Commuter Rail	Fitchburg	Northwest	Low
South Acton	Commuter Rail	Fitchburg	Northwest	Low
South Street	Rapid Transit	Green B	West	Low
Valley Road	Rapid Transit	Mattapan	Southeast	
Waban	Rapid Transit	Green D	West	Low
Waverley	Commuter Rail	Fitchburg	Northwest	Low
Wedgemere	Commuter Rail	Lowell	North	Low
Wyoming Hill	Commuter Rail	Haverhill	North	Low

**Station not rated in 2003 PMT due to very low ridership.

Access to MBTA Stations

Although the primary function of the MBTA is moving people via transit, it is clear that the ease with which services can be accessed—on foot, by bicycle, or by car—is critical to meeting customer demand. The MBTA will continue to work with cities and towns to improve pedestrian access to stations and will take steps to upgrade bicycle amenities at stations, such as providing covered and secure bike storage areas. The MBTA will also continue to promote transit-oriented development to make walking and biking to transit more convenient.

In addition, the availability of parking at commuter rail and rapid transit stations is critical in determining whether public transportation is considered a viable mode, particularly in suburban areas, where 80% of riders access stations via car. To make transit attractive for these customers, the MBTA must consider where and to what extent additional station parking facilities are warranted. However, in addition to increasing the supply of parking, the MBTA will also evaluate parking demand management strategies, such as pricing, to encourage efficient use of resources. The MBTA will also improve the management of its existing parking facilities through implementation of AFC at lots, re-striping to increase capacity, and working with outside parties to encourage carpooling to stations or setting aside parking spaces to support car-sharing programs.

During this PMT cycle, the Commonwealth has committed to building at least 1,000 more MBTA commuter parking spaces by 2011 to accommodating expected growth. Table 6-4 lists MBTA parking lots and prioritizes them using the evaluation criteria discussed in Chapter 3, such as the availability of MBTA-owned land, the potential ease and cost of construction, projected parking demand and utilization, and environmental barriers.

TABLE 6-4
Parking Enhancement Priorities

Parking Lot	Mode	Line	Corridor	Priority
Beverly Depot	Commuter Rail	Newburyport/Rockport	Northeast	High
Bridgewater	Commuter Rail	Plymouth/Kingston	Southeast	High
Forge Park	Commuter Rail	Franklin	Southwest	High
Franklin	Commuter Rail	Franklin	Southwest	High
Kingston	Commuter Rail	Plymouth/Kingston	Southeast	High
Natick	Commuter Rail	Framingham/Worcester	West	High
North Quincy	Rapid Transit	Red	Southeast	High
Quincy Adams	Rapid Transit	Red	Southeast	High
Salem	Commuter Rail	Newburyport/Rockport	Northeast	High
South Attleboro	Commuter Rail	Providence/Stoughton	Southwest	High
Whitman	Commuter Rail	Plymouth/Kingston	Southeast	High
Abington	Commuter Rail	Plymouth/Kingston	Southeast	Medium
Attleboro	Commuter Rail	Providence/Stoughton	Southwest	Medium
Devens-Shirley	Commuter Rail	Fitchburg	Northwest	Medium
Hingham	Boat	Boat	Southeast	Medium
Littleton	Commuter Rail	Fitchburg	Northwest	Medium
Mansfield	Commuter Rail	Providence/Stoughton	Southwest	Medium
Milton	Rapid Transit	Mattapan	Southeast	Medium
Norfolk	Commuter Rail	Franklin	Southwest	Medium
Rockport	Commuter Rail	Newburyport/Rockport	Northeast	Medium
South Weymouth	Commuter Rail	Plymouth/Kingston	Southeast	Medium
Walpole	Commuter Rail	Franklin	Southwest	Medium
Alewife	Rapid Transit	Red	Northwest	Low
Anderson RTC	Commuter Rail	Lowell	North	Low
Andover	Commuter Rail	Haverhill	North	Low
Ashland	Commuter Rail	Framingham/Worcester	West	Low
Auburndale	Commuter Rail	Framingham/Worcester	West	Low
Ayer	Commuter Rail	Fitchburg	Northwest	Low
Ballardvale	Commuter Rail	Haverhill	North	Low
Brockton	Commuter Rail	Plymouth/Kingston	Southeast	Low
Campello	Commuter Rail	Plymouth/Kingston	Southeast	Low
Canton Junction	Commuter Rail	Providence/Stoughton	Southwest	Low
Dedham Corporate Center	Commuter Rail	Franklin	Southwest	Low
Forest Hills	Commuter Rail	Needham	Southwest	Low
Framingham	Commuter Rail	Framingham/Worcester	West	Low
Grafton	Commuter Rail	Framingham/Worcester	West	Low
Halifax	Commuter Rail	Plymouth/Kingston	Southeast	Low
Hamilton/Wenham	Commuter Rail	Newburyport/Rockport	Northeast	Low
Hanson	Commuter Rail	Plymouth/Kingston	Southeast	Low
Haverhill	Commuter Rail	Haverhill	North	Low

TABLE 6-4 (cont.)
Parking Enhancement Priorities

Parking Lot	Mode	Line	Corridor	Priority
Holbrook/Randolph	Commuter Rail	Plymouth/Kingston	Southeast	Low
Hyde Park	Commuter Rail	Franklin; Providence/ Stoughton	Southwest	Low
Kendal Green	Commuter Rail	Fitchburg	West	Low
Lincoln	Commuter Rail	Fitchburg	Northwest	Low
Lowell	Commuter Rail	Lowell	North	Low
Malden Center	Commuter Rail	Haverhill	North	Low
Malden Center	Rapid Transit	Orange	North	Low
Middleborough/Lakeville	Commuter Rail	Plymouth/Kingston	Southeast	Low
Montello	Commuter Rail	Plymouth/Kingston	Southeast	Low
Needham Heights	Commuter Rail	Needham	West	Low
Needham Junction	Commuter Rail	Needham	West	Low
Newburyport	Commuter Rail	Newburyport/Rockport	Northeast	Low
North Billerica	Commuter Rail	Lowell	North	Low
Norwood Center	Commuter Rail	Franklin	Southwest	Low
Norwood Depot	Commuter Rail	Franklin	Southwest	Low
Readville	Commuter Rail	Fairmount	Southwest	Low
Readville	Commuter Rail	Franklin	Southwest	Low
Route 128	Commuter Rail	Providence/Stoughton	Southwest	Low
Rowley	Commuter Rail	Newburyport/Rockport	Northeast	Low
Sharon	Commuter Rail	Providence/Stoughton	Southwest	Low
South Acton	Commuter Rail	Fitchburg	Northwest	Low
Southborough	Commuter Rail	Framingham/Worcester	West	Low
Stoughton	Commuter Rail	Providence/Stoughton	Southwest	Low
Wellesley Square	Commuter Rail	Framingham/Worcester	West	Low
Wellington	Rapid Transit	Orange	North	Low
West Medford	Commuter Rail	Lowell	North	Low
West Natick	Commuter Rail	Framingham/Worcester	West	Low
Westborough	Commuter Rail	Framingham/Worcester	West	Low
Wilmington	Commuter Rail	Lowell	North	Low
Winchester	Commuter Rail	Lowell	North	Low
Wollaston	Rapid Transit	Red	Southeast	Low
Worcester	Commuter Rail	Framingham/Worcester	West	Low

Bus Rapid Transit (BRT)

BRT incorporates any number of ITS, infrastructure, and operational strategies that can be implemented to create a rapid-transit-like service using rubber-tired vehicles. These may include a dedicated right-of-way, pre-paid boarding areas, signal timing, stop consolidation, bulb-outs at bus stops, CAD/AVL (computer-assisted dispatch/automatic vehicle locator), PAVMS (public address and variable-message signs), low-floor vehicles, etc. A recent CTPS study of bus Route 39 shows that a combination of signal timing, stop consolidation, and curb extensions can generate a travel time savings between 2.5% and 26.5%.[1]

Another recent CTPS study[2] investigated the future demand for bus service and recommended routes on which more service will be needed. For the most part, these routes include the Key Routes and selected other routes throughout the system. Recommendations are being made in this PMT that BRT elements be implemented on all of the Key Routes. Some of these routes would be enhanced through projects, such as the Urban Ring, while other routes would need to be addressed individually. A careful study of existing conditions, including roadway geometry and traffic congestion, is needed before BRT could be implemented on any of the recommended routes.

The current Key Routes include:

- Route 1: Dudley – Harvard via Mass. Ave.
- Route 15: St. Peter's Square – Ruggles via Dudley
- Route 22: Ashmont – Ruggles via Grove Hall
- Route 23: Ashmont – Ruggles via Codman Square
- Route 28: Mattapan – Ruggles
- Route 32: Wolcott Square – Forest Hills
- Route 39: Forest Hills – Back Bay
- Route 57: Watertown – Kenmore via Oak Square
- Route 66: Harvard – Dudley via Allston
- Route 71: Watertown Square – Harvard via Mount Auburn St.
- Route 73: Waverley – Harvard via Mount Auburn
- Route 77: Arlington Heights – Harvard via Mass. Ave.
- Route 111: Woodlawn – Haymarket Station
- Routes 116 & 117: Broadway at Park Avenue – Maverick Station (the corridor in which the trunk portions of both routes operate is assigned Key Bus Route status)
- Silver Line Washington Street: Dudley Station – Downtown Crossing via Washington St. and Silver Line Waterfront: South Station – Silver Line Way

Route 31 (Mattapan – Forest Hills) was recommended for inclusion as a Key Route in the 2008 Service Plan. Other routes on which future BRT elements would be beneficial include Route 86 (Sullivan – Reservoir) and Route 89 (Clarendon Hill or Davis – Sullivan). The routes listed above that may be addressed through the Urban Ring project include 15, 116/117, and 86.[3] Route 89 may be addressed through the Green Line extension to Medford. All of these routes are discussed in the context of the corridors in which they are located.

The Key Routes were designated as such because they operate in the most heavily traveled corridors in the transit system and carry approximately 40% of the MBTA bus ridership. In general, the Key Routes serve the densely populated urban core where many residents are minority and/or low-income and depend on MBTA services as their primary means of mobility. Of the

1 Mark S. Abbott and Efi Pagitsas, *"MBTA Transit Signal Priority Study: Arborway Corridor,"* Central Transportation Planning Staff, December 4, 2008.

2 Jonathan Belcher, *"MBTA Bus Deployment Needs Study,"* Central Transportation Planning Staff, July 31, 2008.

3 The CT1, CT2, and CT3 bus routes were implemented as precursors to the Urban Ring and have planned BRT elements in the context of that project.

17 Key Routes,[4] 12 are classified as minority and 6 as both minority and low-income for the purposes of Title VI.[5] Routes 86 and 89, which are not Key Routes, are both minority routes as well. Implementing BRT on these routes would help to ensure that the MBTA's core constituents share in the benefits of improved transit services.

Bus Fleet Expansion

By 2030, modeling projections suggest that, systemwide, 30 bus routes, including the routes discussed above for possible implementation of BRT elements, would experience passenger crowding levels that would trigger the need for additional service. To increase peak-period capacity and to ensure that vehicle loads do not exceed safe and comfortable levels, at least 50 additional 40-foot buses and 11 additional 40-foot trackless trolleys would be required by 2030 to operate all of these routes. Replacing existing 40-foot buses with 60-foot buses would be another method for increasing capacity to meet user demand and would be assumed on routes that are converted to BRT. Additional vehicles would also be necessary to accommodate possible new circumferential routes, which are discussed later in this chapter.

The discussion of enhancement and expansion projects for each PMT corridor begins on page 6-14.

4 Routes 116 and 117 are counted as one route, and the two parts of the Silver Line are counted separately.

5 See Chapter 1 for an explanation of how routes are designated as minority and/or low-income for Title VI.

CORRIDOR PROJECTS

In this section, project options that are geographically based are discussed in the context of a PMT radial corridor—Northeast, North, Northwest, West, Southwest, or Southeast—or the Central Area/Circumferential Corridor.

For the purposes of the PMT, the Central Area consists of Boston Proper and the surrounding urban areas. Boston Proper is the part of the city that lies northeast of Massachusetts Avenue and is bordered by the Charles River, Boston Harbor, Fort Point Channel, and the Southeast Expressway. Outside of Boston Proper the Central Area is composed of most of Boston's neighborhoods (excluding Hyde Park, Roslindale, West Roxbury, and Mattapan) and nine communities that surround the city: Brookline, Cambridge, Somerville, Medford, Malden, Everett, Chelsea, Revere, and Winthrop. The cities and neighborhoods in the Central Area that encircle Boston Proper form a Circumferential Corridor that cuts across all six radial PMT corridors. Many of the MBTA's bus and rapid transit services operate within the Central Area, and all of the radial rapid transit and commuter rail services converge within Boston Proper.

The Northeast Corridor extends from East Boston and Logan Airport to Cape Ann, the Merrimack River, and the New Hampshire state line at Newburyport and Salisbury. The Newburyport and Rockport commuter rail lines are within this corridor, as well as the Blue Line and a number of MBTA bus routes, which are in the closer-in parts of the corridor.

The North Corridor also extends to New Hampshire. It includes the Boston neighborhood of Charlestown and the municipalities near the Haverhill and Lowell commuter rail lines. Some proposals described here involve extending commuter rail service into New Hampshire. Closer in, the North Corridor is served by the Orange Line, as well as a number of MBTA bus routes.

The Northwest Corridor generally follows the Fitchburg commuter rail line. It includes Cambridge and Somerville at the inner end, and extends to the municipalities of Townsend, Ashby, and Ashburnham, which border on New Hampshire. The Red Line currently serves Cambridge and Somerville, and a number of buses connect with the Green Line terminus in the Lechmere neighborhood of Cambridge.

The West Corridor extends from Boston Proper at Massachusetts Avenue in the Back Bay to Worcester and its surrounding municipalities. All the municipalities on or near the Worcester commuter rail line are included in this corridor. The B, C, and D Branches of the Green Line serve the inner suburbs of Newton and Brookline, and the Brighton neighborhood of Boston.

The Southwest Corridor also starts at Massachusetts Avenue, and includes the Boston neighborhoods of Roxbury, Jamaica Plain, West Roxbury, and Hyde Park. The corridor includes municipalities on or near the Franklin, Providence, and Stoughton commuter rail lines, and extends to the Rhode Island state line. The Boston neighborhoods are served by the Orange Line, as well as by the E Branch of the Green Line.

The Southeast Corridor includes the Boston neighborhoods of Dorchester and Mattapan, and extends to Cape Cod. The municipalities on or near the three branches of the Old Colony commuter rail lines comprise this corridor. The inner areas are served by the Red Line, Mattapan High Speed Line, and a number of MBTA bus routes.

MAP 6-1
PMT Corridors

CENTRAL AREA

Boston Proper

The key transit improvement challenges in the Central Area are to better interconnect existing transit services and to expand system capacity. Despite the crossing of the Central Area by the various subway lines, it still requires a "three-seat-ride" entailing two transfers to travel from a non-downtown station on the Red Line to a non-downtown station on the Blue Line. Similarly, two transfers are required for travel between points on the Silver Line Waterfront and the Silver Line Washington Street. Also, at least two transfers are required to travel on the rapid transit system between the North Side and South Side commuter rail systems.

Related to the problem of poor connectivity is the need to expand capacity. Crowding is a problem on subway trains today, especially on the Green Line. Three-car trains and a Park Street crossover track are possible capacity improvements. Also, stub-end commuter rail terminals seriously restrict the maximum number of train operations, and South Station is steadily approaching the point at which it will not be able to accommodate additional peak-period trains.

Red–Blue Connector

This project would extend the Blue Line, providing a connection between Government Center Station in Boston and Charles/MGH Red Line station, allowing a direct transfer between these lines. This would be a 0.4-mile extension (from Bowdoin Station), entirely in a new subway, including the addition of a new level to Charles/MGH Station. Design of the Blue–Red Connector is an Administrative Consent Order (ACO) legal commitment.

Silver Line Phase III

This project would construct a new transitway tunnel from South Station to Charles Street South, with intermediate stops at Boylston and Chinatown Stations. The segment would link Phase I, Silver Line Washington Street, which runs between Dudley Square and Downtown Crossing, with Phase II, Silver Line Waterfront, which runs between South Station and Logan Airport via the World Trade Center. The Phase III segment would also allow for direct transfers from all segments of the combined Silver Line with the Red, Orange, and Green Lines. Operation would necessitate the purchase of additional dual-mode vehicles. The possibility of providing surface connections in the interim is currently being discussed.

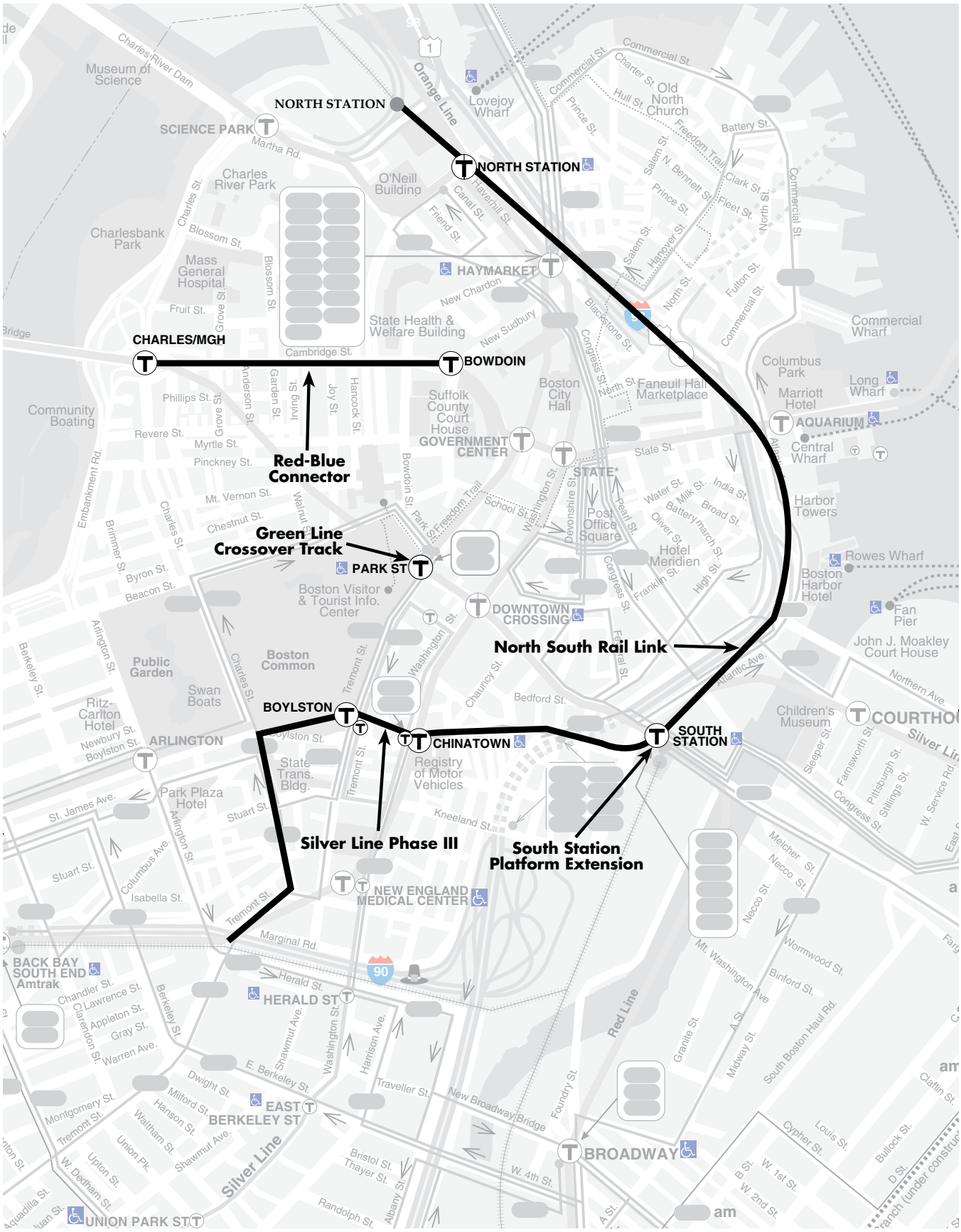
Additional Tracks at South Station

Expansion of the southside commuter rail system has steadily increased demand for peak-period track capacity at South Station. Meeting the need for additional capacity would be a key element of projects such as the expansion of commuter rail service to Fall River and New Bedford. The addition of up to six tracks is being discussed as an integral component of the envisioned redevelopment of the U.S. Postal Service South Station Annex.

North–South Rail Link

This project would provide a connection through downtown Boston between the rail lines that terminate at North Station and those that terminate at South Station, allowing through-routing of trains between North side and South side lines. It would consist of a four-track tunnel over one mile long, with new underground stations in the vicinities of North Station, South Station, and potentially a new central station near the Aquarium rapid transit station. The Rail Link would also eliminate the inherent constraints of stub-end terminal operations.

MAP 6-2
Central Area Potential Improvements



The Circumferential Corridor

The transit system in metropolitan Boston developed as a radial system, with rapid transit and commuter rail lines converging in the core, and in some cases extending across the core and continuing on. This configuration has worked well for many radial trips, most often work trips. Land use patterns in recent decades, however, have resulted in a number of strong trip-generating areas developing at locations just outside the Central Area, as well as further into the suburbs between the Central Area and Route 128.

Circumferentially oriented transit services would provide quicker and more direct connections for those who both live and work outside of the Central Area. In addition, circumferential services would relieve pressure on the central subway by eliminating the need for a commuter to travel into the inner core in order to travel out to his/her ultimate destination. While travel volumes might not necessarily require or justify rail-based transit service, lower-cost ways of improving circumferential transit do exist, and evaluating these services is clearly a priority of the PMT.

Urban Ring

The Urban Ring is a proposed major new bus rapid transit (BRT) system that would run in a roughly circular corridor through employment centers, residential neighborhoods, and major educational and medical institutions in Boston, Brookline, Cambridge, Chelsea, Everett, Medford, and Somerville. The Urban Ring would provide faster and more direct transit connections between points in the ring and from the MBTA's existing radial rapid transit system to destinations in the ring. The project would also include BRT service enhancements to enable buses to operate more like rapid transit. As a result, the Urban Ring would improve transit access and travel times and capacity while reducing crowding in the central subway system and offering opportunities for transit-oriented, smart-growth development.

Given the significant capital costs associated with the Urban Ring project and the competition for limited state and federal transportation funds, the Executive Office of Transportation and Public Works is currently exploring options for phased implementation of this project. Under this approach, a segment (or segments) of the recommended alignment could be targeted for full or partial implementation of capital improvements and BRT service identified in the Revised Draft Environmental Impact Report/Draft Environmental Statement.

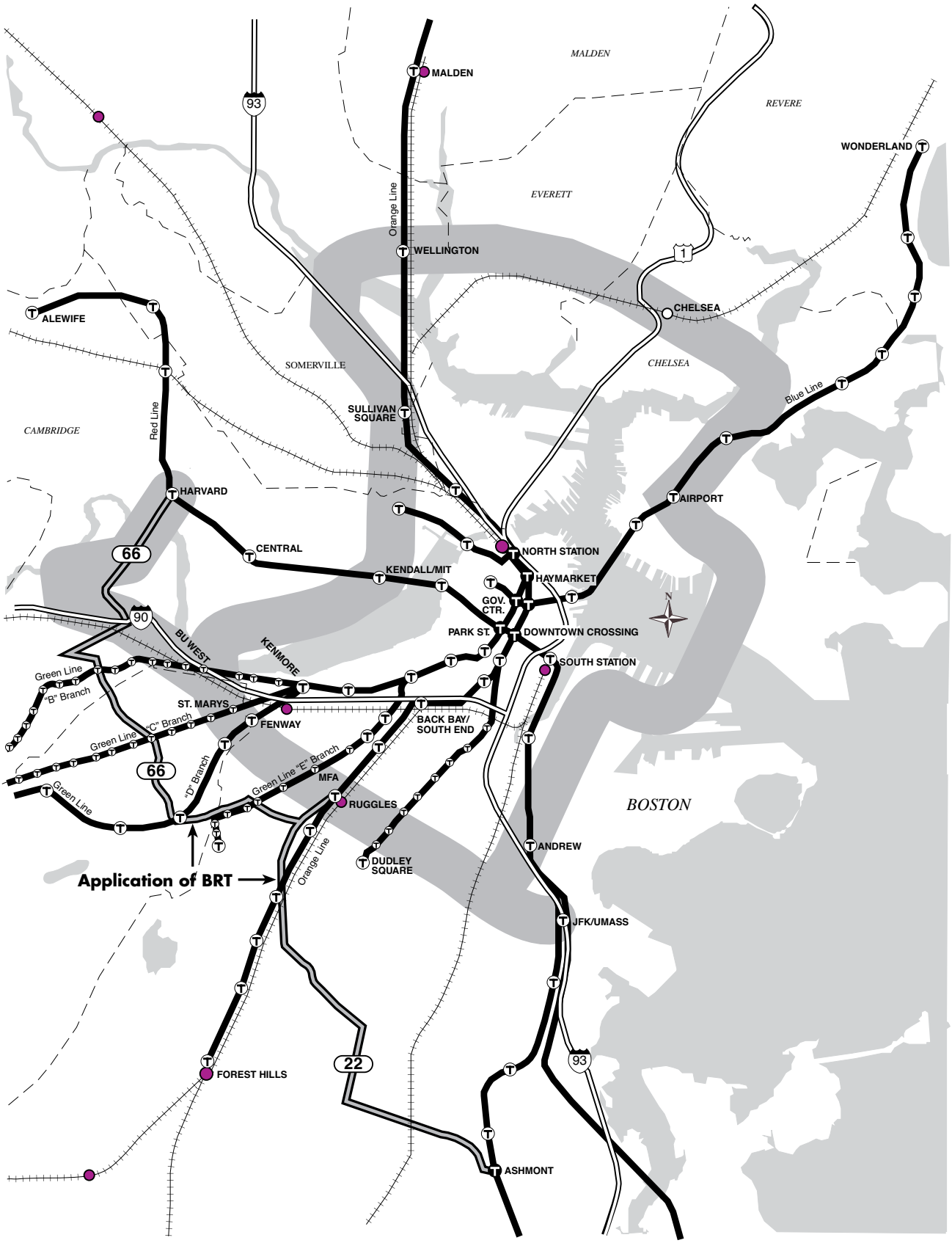
BRT Elements on Bus Routes 22 and 66

The PMT envisions that across the MBTA system there are opportunities to enhance key existing bus routes through the application of BRT features and technologies. Just outside the Urban Ring corridor, Routes 22 and 66 are operated along circumferential alignments and experience ridership high enough to perhaps justify some level of investment in BRT-type improvements. Route 22 operates between Ashmont Station on the Red Line and Ruggles Station on the Orange Line. Route 66 operates between Dudley and Harvard Squares, crossing Route 22 at Roxbury Crossing.

Suburban Circumferential Options

Further out from the Urban Ring corridor, but within Route 128, there may exist opportunities to establish additional circumferential routes where potential ridership either exists now or could be expected to develop. Preliminary investigations have identified strong activity centers in adjacent radial corridors and cataloged any currently available transit services that operate circumferentially between these centers. Later analysis will project ridership and identify opportunities for BRT-like improvements.

MAP 6-3
Circumferential Corridor Potential Improvements



NORTHEAST CORRIDOR

In the Northeast Corridor, the PMT analysis has been focused on the older industrial cities of Lynn, Peabody, Salem, and Beverly. Lynn, Salem, and Beverly have commuter rail service, which was strengthened in the previous decade by the Newburyport extension. There is already substantial MBTA bus service in the inner part of the corridor, and improving the bus network figures prominently in the PMT options. Also of importance are possible improvements to the Blue Line, which anchors the inner Northeast Corridor in East Boston and Revere.

Newburyport/Rockport Capacity Improvements

Some capacity constraints still exist on the Newburyport/Rockport Line, primarily due to areas of single track. These include 0.8 miles through the Salem Tunnel on the trunk portion of the line, as well as almost 15 miles on the Newburyport Branch between North Beverly and Newburyport, and 4 miles between Control Point Wilson in Gloucester and Rockport Station on the Rockport Branch. Double-tracking these areas would decrease the potential for delays when schedules are tight or when trains are operating off-schedule, and would allow for additional service in the future.

Blue Line Extension to Lynn

This project would build one new rapid transit station and extend the Blue Line rapid transit line 4.5 miles from Wonderland Station in Revere to Central Square, Lynn. The alignment would either be parallel to the Newburyport/Rockport commuter rail line or would make use of the abandoned narrow-gauge right-of-way through Oak Island Center and Point of Pines Center. The extension would also include a crossing of the Saugus River, which is a navigable waterway. Consequently, a bridge would need to accommodate both large vessels on the river and high-frequency rapid transit service. Additional Blue Line vehicles would need to be purchased to operate the service. It should be noted that this extension of the Blue Line is intended to complement—not replace—existing commuter rail service to the North Shore.

BRT Elements on Bus Route 111

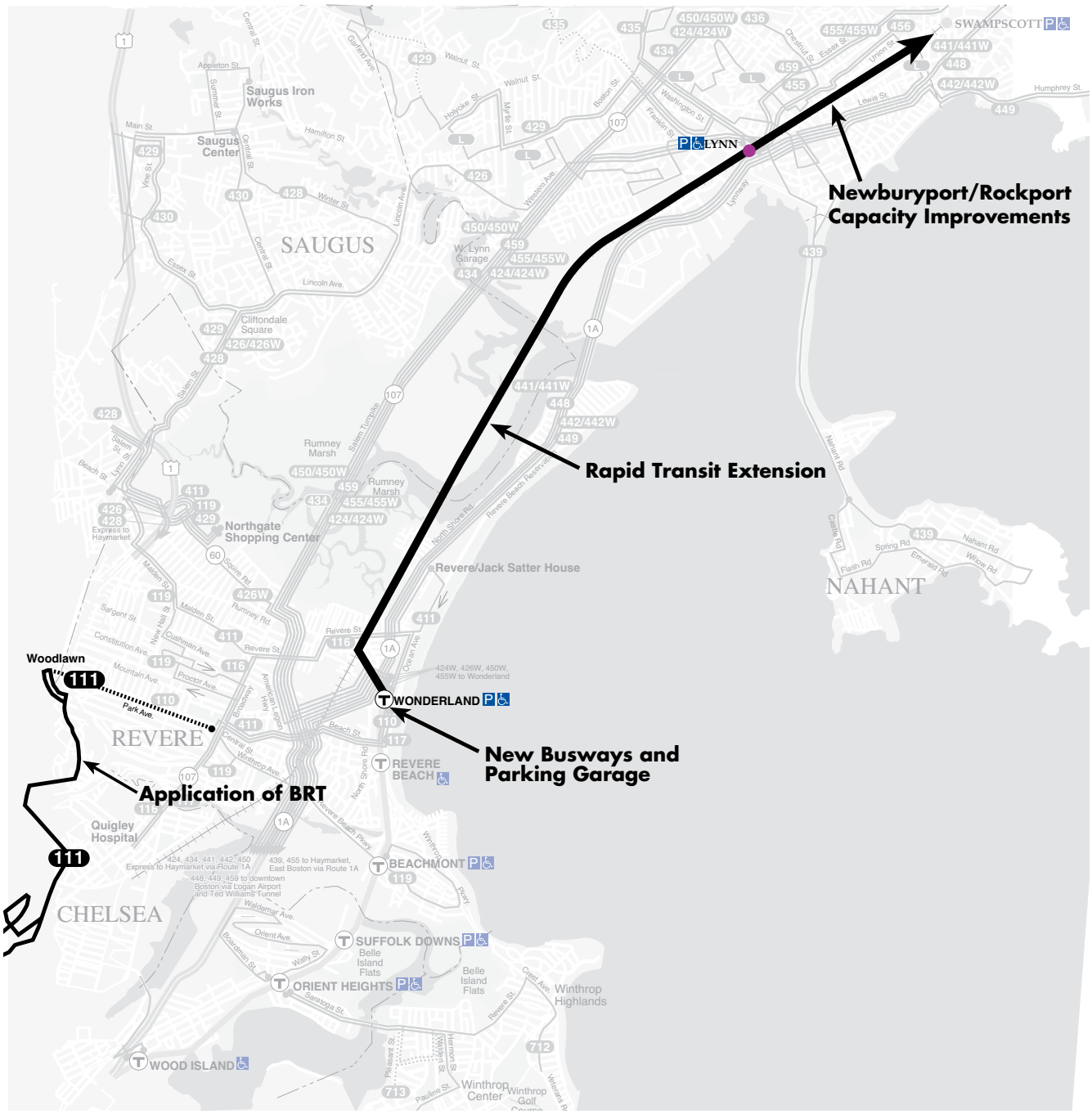
The PMT envisions that across the MBTA system there are opportunities to enhance key existing bus routes through the application of BRT features and technologies. Bus Route 111 is a heavily used route between the Haymarket bus station and Woodlawn Cemetery at the Chelsea-Everett line. The route already benefits from traveling at freeway speeds across the Tobin Bridge. BRT elements in downtown Chelsea would establish this route as a premium radial bus service.

Improved Bus Amenities and System Identity in Lynn, Peabody, Salem, and Beverly

The MBTA bus routes in these inner Northeast Corridor cities are often perceived as primarily Boston-oriented radial services that connect either to Boston directly, or feed the several commuter rail stations in the corridor. With distinct and improved signage, amenities at key bus terminals, and selected route expansions, it is possible that the bus route system in these cities would be perceived as a comprehensive local bus system. Ridership growth would be encouraged, and land use patterns would gradually respond to stronger transit service patterns. Service expansion to West Peabody would be considered as part of such a program.

The bus system in the Northeast Corridor would also be strengthened by the construction of new busways at Wonderland Station. These busways would be positioned on the Route 1A side of the station to allow for much easier access to this important roadway. Station parking would also be consolidated in a multi-level structure adjacent to Route 1A, freeing up valuable parcels on the Revere Beach side of the Blue Line for transit-oriented development.

MAP 6-4
Northeast Corridor Potential Improvements



NORTH CORRIDOR

North Corridor Outer Area

Two of the MBTA commuter rail lines serve the North Corridor, terminating at the historic mill cities of Lowell and Haverhill. Substantial numbers of commuters living in New Hampshire travel to Massachusetts utilizing both these lines. Extensions of these lines into New Hampshire and related improvements are being considered in the PMT.

Lowell Commuter Rail Line Extension

This project would implement commuter service on an existing rail freight line from the end of the Lowell Line, initially to Nashua, New Hampshire. This would be a 13-mile extension and would include one new station in Massachusetts at North Chelmsford. Extensive upgrading of tracks and signals would be required. Passenger service was last operated on this line in 1981.

This extension would be undertaken in cooperation with the state of New Hampshire, and could, at some point, include service as far as Manchester. A stop at Merrimack, New Hampshire, would be possible, as well as convenient shuttle bus service to the Manchester Airport. The New Hampshire Department of Transportation and the Merrimack Valley Planning Commission have been investigating the possibility of extending transit service from the North Corridor into New Hampshire. Options include the extension of commuter rail to Manchester and "bus on shoulder" treatment on I-93.

Haverhill Commuter Rail Line Extension and Related Improvements

This project would implement commuter service on an existing rail line, from the end of the Haverhill Line to Plaistow, New Hampshire. This 5.4-mile service extension would not require track upgrading because the line is currently used by Amtrak's Boston–Portland Downeaster service. A new station with parking facilities would be built in Plaistow, and one additional train set would be required to maintain schedules because of the increased running time.

Other improvements of the Haverhill Line are also being considered, some of which could be implemented in conjunction with the Plaistow extension. The train equipment layover facility is currently in Bradford, a Haverhill neighborhood just south of the Merrimack River. A new layover facility north of Haverhill could be built as part of the extension and would offer operational and environmental benefits.

Much of the Haverhill Line is single-track, seriously limiting schedule and operational flexibility; therefore, expanded double-tracking of the Haverhill Line should be considered. The operational flexibility of a double-track line would facilitate both the lengthening of the line to Plaistow and the addition of any new stations. Areas in need of double-tracking include approximately 4 miles between Reading Junction and Melrose, 14 miles between Reading and the Andover Street interlocking in Lawrence, and all of the Wildcat Branch that connects the Lowell and Haverhill Lines. In addition, new stations on the Haverhill Line have been suggested for locations in North Andover, at Lowell Junction in Andover, and in Wilmington.

MAP 6-5
North Corridor Outer Area Potential Improvements

North Corridor Inner Area

New Orange Line Station at Assembly Square and Related Improvements

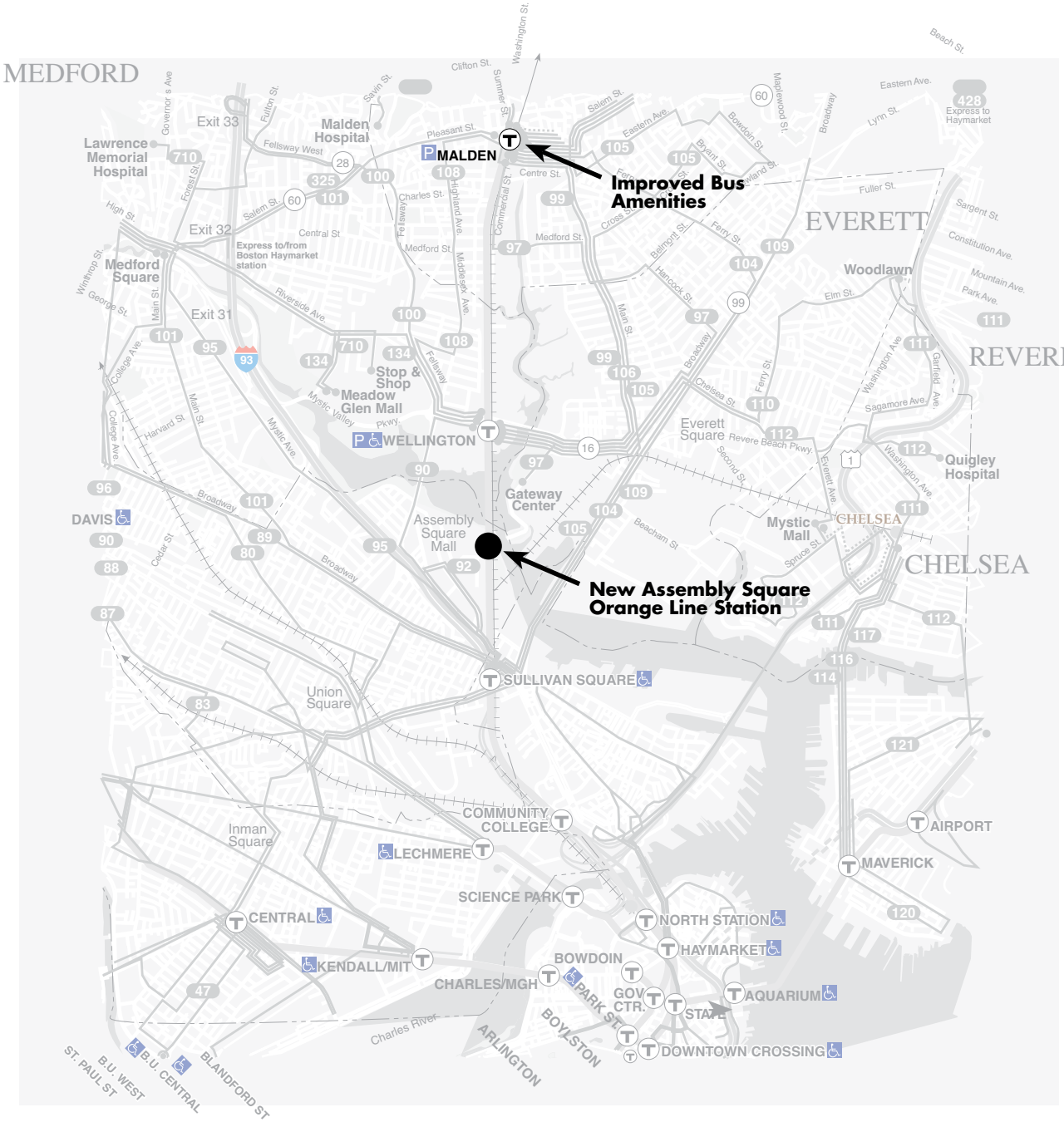
This project would add a station on the existing Orange Line at Assembly Square in Somerville, between Sullivan Square Station in Charlestown and Wellington Station in Medford. Major transit-oriented mixed-use redevelopment is currently underway at Assembly Square, for which the new station is an integral component. No additional route mileage would be added as a result of this improvement.

Recently completed upgrades of the Orange Line signaling system have made it possible to increase rush-hour frequencies. An expanded fleet of Orange Line equipment would be required to realize these service improvements. Increasing the size of the Orange Line fleet will be considered in conjunction with replacing the current equipment, which dates from the early 1980s.

Improved Bus Amenities and System Identity for Bus Routes Centered on Malden

Malden is seen as a logical central point for developing a strong bus service identity. Malden Center enjoys significant density by suburban standards, is served by the Orange Line and commuter rail, and is already the terminus of a number of bus routes. With distinct and improved signage, amenities at key bus terminals, and selected route expansions, it is possible that the Malden-centered bus routes would be perceived as a comprehensive local bus system. One potential bus service expansion that could be considered is building a BRT busway in an abandoned east-west freight rail right-of-way near Malden Center.

MAP 6-6
North Corridor Inner Area Potential Improvements



NORTHWEST CORRIDOR

Northwest Corridor Outer Area

Fitchburg Commuter Rail Line Improvements

The Fitchburg Line is currently the longest MBTA commuter rail branch, a fact that is reflected in long scheduled running times. There is heavy freight service along parts of the route, and significant portions of the route have only a single track.

Improving Fitchburg Line travel speeds has been identified as a priority, and several proposals are being considered toward this end. An investment in expanded double-tracking at Newton Street in Waltham, and between South Acton and Ayer, would improve Fitchburg Line performance by decreasing the potential for delays when schedules are tight or when trains are operating off-schedule and would increase the capacity of the line. The consolidation of the three Weston stations is under consideration, possibly in conjunction with a new station at Route 128. Also, a major station near Fort Devens with extensive parking might replace one or more nearby stations. Less capital-intensive signaling and operational improvements are also being evaluated.

Possible New Commuter Rail Services Using the Fitchburg Line

Upon upgrading the Fitchburg Line, it would be possible to extend commuter service on an existing heavily used rail freight line from Fitchburg to Gardner. A new station with parking facilities would be built in Gardner, and service to Westminster, near the Mount Wachusett recreation area, would also be possible. This would be a 15.6-mile extension, and significant upgrading of tracks and signals would be required to accommodate passenger service, which was last operated to Gardner in 1986.

Another possible new service would be to operate trains from Fitchburg to Boston via Lowell. Trains would use the freight mainline from Fitchburg all the way to Lowell, with possible stops in Westford and Chelmsford, and then continue to Boston along the current Lowell Line.

MAP 6-7
Northwest Corridor Outer Area Potential Improvements

Northwest Corridor Inner Area

Green Line Extension to Medford Hillside and Union Square

This project would extend Green Line service from Lechmere Station to Medford as part of an expanded Lowell commuter rail line right-of-way. Also included in the project is a branch between Lechmere Station and Union Square in Somerville. This Green Line extension would include six new stations, as well as a relocated Lechmere Station. A Green Line extension to Medford Hillside is a legal commitment of the Commonwealth for state compliance with Central Artery/Tunnel mitigation and the federal Clean Air Act.

Red Line Extension to Arlington and Lexington

An extension of the Red Line beyond Alewife is another potential rapid transit expansion in the Northwest Corridor. This expansion has been the subject of periodic review since it was removed from the Red Line extension project in the 1970s. This would be an 8.3-mile extension from Alewife Station in Cambridge to Route 128 via the former Lexington Branch railroad alignment (now the route of the Minuteman Bikeway). It would include five new stations in Arlington and Lexington, with a major park-and-ride facility at the outer terminal. It is envisioned that this line would be below grade, and the recreational trail would be reconstructed over the tunnel roof.

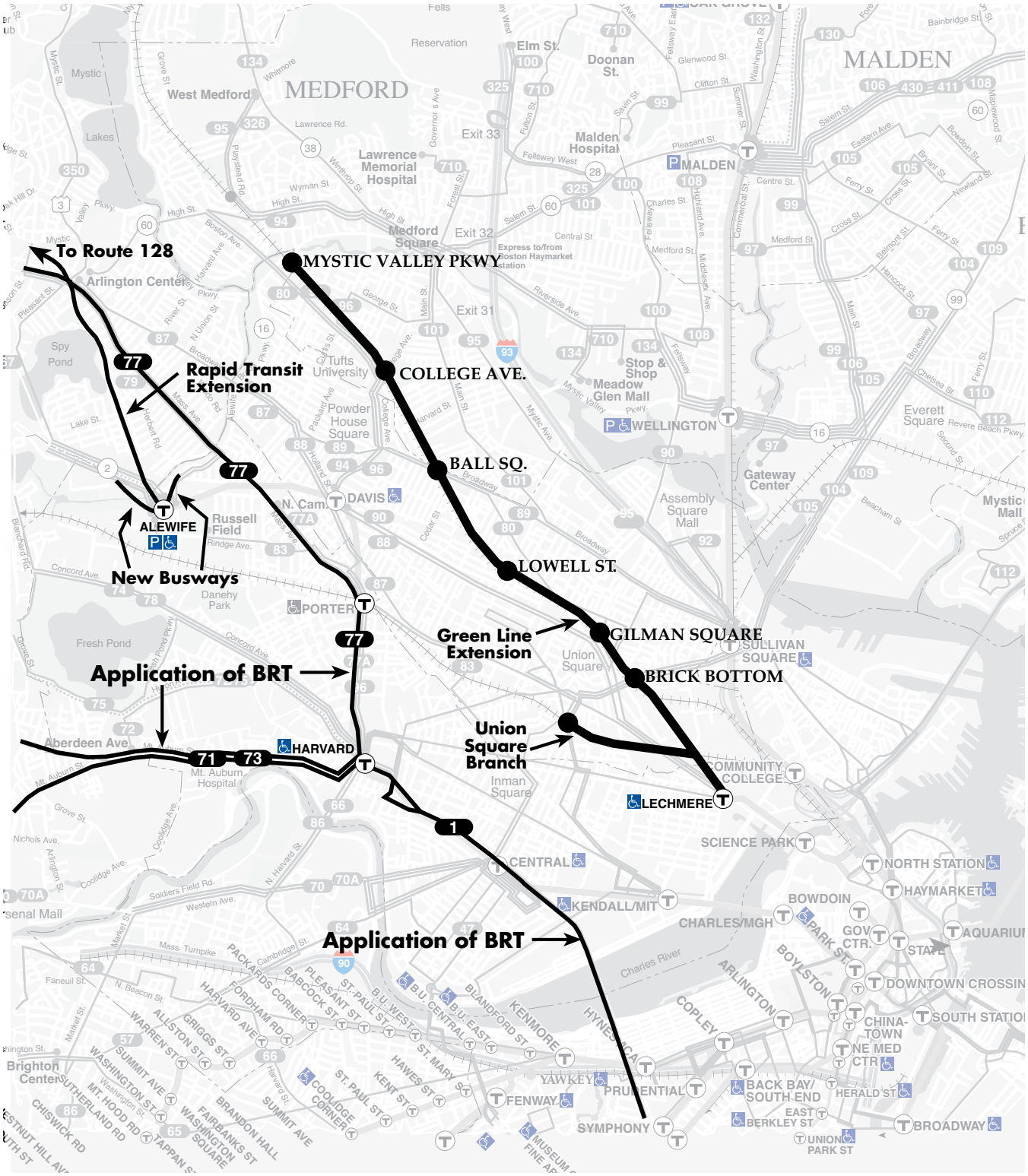
BRT and Related Bus System Improvements

The PMT envisions that across the MBTA system there are opportunities to improve key existing bus routes through the application of BRT features and technologies. In the Northwest Corridor, bus Routes 1, 71, 73, and 77 are heavily used and are viewed as promising candidates for BRT-type improvements. These routes all begin at Harvard Square and connect it with Dudley, Watertown, and Waverly Squares, as well as Arlington Heights near the Lexington town line. BRT improvements could include signal priority for buses, dedicated lanes, and stop consolidation.

Another BRT-type improvement would be constructing exclusive bus lanes to improve access to Alewife Station. Routes 79 from Arlington Heights and 350 from Burlington would use new bus-only lanes along Alewife Brook Parkway from Massachusetts Avenue. Routes 62 from Bedford, 67 from Turkey Hill, 76 from Hanscom Field, and 84 from Arlmont would use new bus-only lanes along Route 2 from Lake Street.

Waltham is seen as a logical central point for developing a strong bus service identity. Downtown Waltham enjoys significant density by suburban standards, and a number of bus routes terminate at the commuter rail station. Waltham has a second, well-used, commuter rail station at Brandeis University. With distinct and improved signage, amenities at key bus terminals, and selected route expansions, it would possible that the Waltham-centered bus routes would be perceived as a comprehensive local bus system. New demand-responsive or fixed-route services could be developed through partnerships with other service providers, municipalities, or the Boston Region Metropolitan Planning Organization (MPO) to complement existing and potential MBTA services.

MAP 6-8
Northwest Corridor Inner Area Potential Improvements



WEST CORRIDOR

Expanding Worcester Commuter Rail Line Service and Related Improvements

The highest priority in the West Corridor is to expand service on the Worcester commuter rail line. The right-of-way west of Framingham currently owned by the CSX Corporation, is used intensively for freight service. The Commonwealth and CSX recently reached an agreement in principal for the state to purchase this line, with the intent to ultimately increase the Boston–Worcester round-trips to 20 from today's 12. This service expansion would require investment in tracks, signals, and rolling stock. This commuter rail service expansion would be compatible with the desire by the Commonwealth to also improve and expand freight rail service in Massachusetts.

A number of other improvements have been envisioned for the Worcester Line. The current Yawkey Station would be upgraded in conjunction with major anticipated new development in the Kenmore Square area. With full ADA accessibility to both tracks, and stronger area demand patterns, the number of trains stopping at Yawkey would significantly increase.

Less than two miles west of Yawkey Station is the neighborhood of Allston, bisected by the Turnpike and the CSX freight yard. A possible new station in Allston is currently being studied, as are other services and station options promoted by the City of Boston and Harvard and Boston Universities, the Turnpike Authority, and the CSX Corporation. A number of alternatives are still under consideration.

Increasing capacity west of Framingham would allow consideration of further expansion of commuter rail service in an existing rail right-of-way. One possibility would be an extension of rail service beyond Worcester to Springfield in a corridor that currently carries Amtrak passenger trains. Another possibility would be service between Boston and Worcester via Ayer on the Fitchburg Line. This service would operate in a right-of-way that currently carries only freight and would require significant upgrading for commuter rail service.

Another enhancement that could be made on the Framingham/Worcester Line would be double-tracking for approximately 3 miles between South Station and Beacon Yard. This would decrease the potential for delays when schedules are tight or when trains are operating off schedule and would increase service capacity.

BRT Elements on Bus Route 57 and Other Bus System Improvements

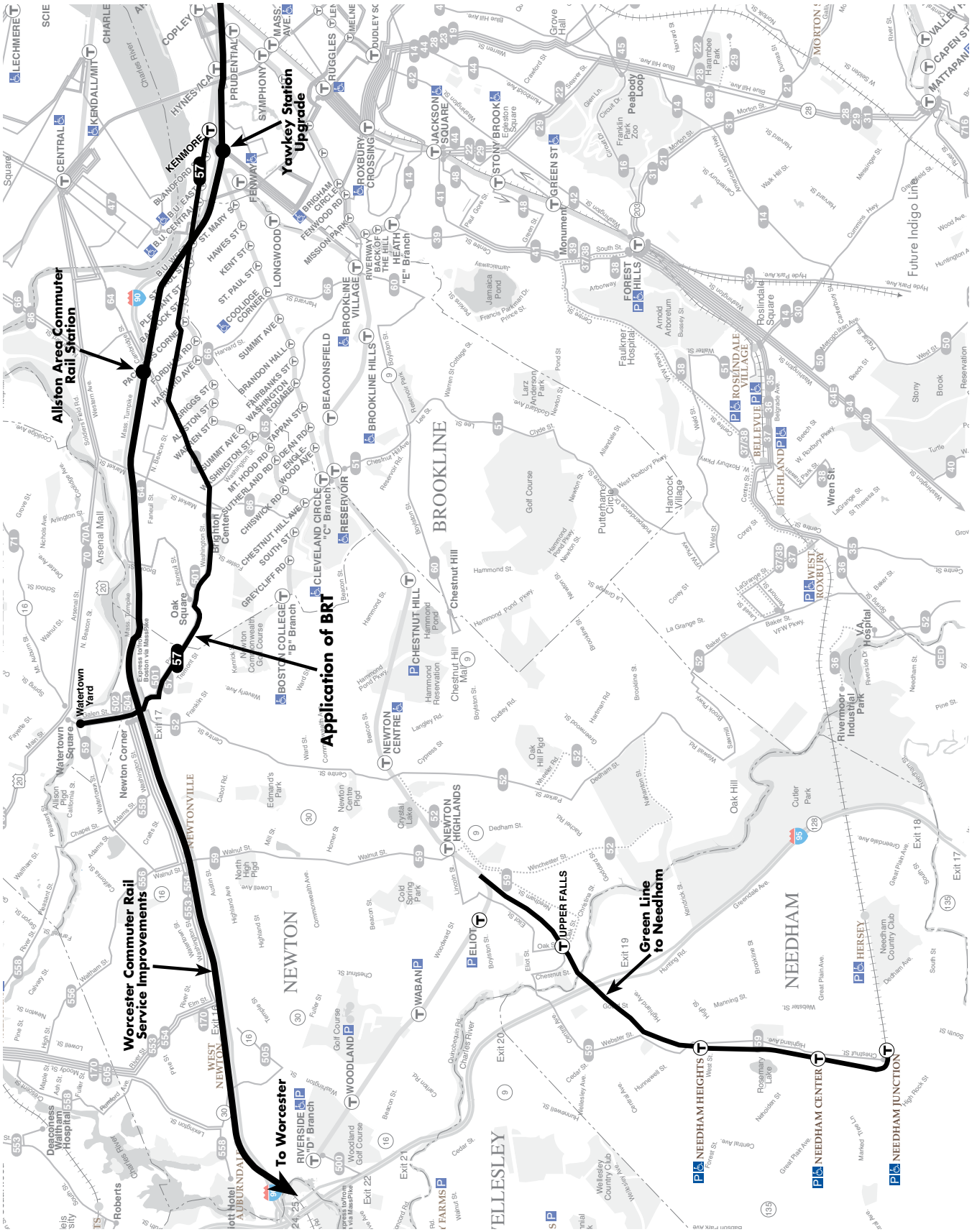
The PMT envisions that across the MBTA system there are opportunities to improve key existing bus routes through the application of BRT features and technologies. Bus Route 57 is a heavily used route between Watertown and Kenmore Squares. Implementing BRT elements could establish this route as a premium radial bus service. In suburban areas, demand-responsive or fixed-route services could be developed through partnerships with other service providers, municipalities, or the Boston Region MPO to complement existing and potential MBTA services.

Green Line Improvements

The B, C, and D Branches of the Green Line operate in the West Corridor and enjoy very heavy ridership. Expanding the vehicle fleet and introducing three-car trains would reduce crowding and speed boardings on these lines.

An opportunity exists to create a new branch from the Riverside Line to Needham. This new Green Line branch would diverge from the D Branch near Eliot Station and follow the alignment of an unused rail-freight line 3.8 miles to Needham Junction, which would become the last stop of the commuter rail line. There would be a new Green Line stop in Newton, as well as at the current commuter rail stops at Needham Heights and Needham Center, which would become Green Line stops.

MAP 6-9
West Corridor Potential Improvements


Yawkey Station Upgrade
Allston Area Commuter Rail Station
Application of BRT
Worcester Commuter Rail Service Improvements
To Worcester
Green Line to Needham
Future Indigo Line
BROOKLINE
NEWTON
NEEDHAM
WELLESLEY
KENMORE
COPLEY
PRUDENTIAL
SYMPHONY
MASS. AVE.
RUGGLES
DUDLEY SQ
ROXBURY CROSSING
JACKSON SQUARE
STONY BROOK
GREEN ST
FOREST HILLS
ROSLINDALE VILLAGE
HIGHLAND
BELLEVUE
WEST ROXBURY
BROOKLINE VILLAGE
BROOKLINE HILLS
BEACONSFIELD
RESERVOIR
CLEVELAND CIRCLE
CHESTNUT HILL
NEWTON CENTRE
NEWTON HIGHLANDS
ELIOT
WABAN
WOODLAND
RIVERSIDE
WATERTOWN SQUARE
WATERTOWN YARD
OAK SQUARE
BRIGHTON CENTER
NEWTON CORNER
WEST NEWTON
AUBURNDALE
HEATH ST
LONGWOOD
FENWAY
KENMORE
CENTRAL
KENDALL/MIT
LECHMERE
HAWES ST
KENT ST
ST. PAUL ST
COOLIDGE CORNER
SUMMIT AVE
BRANDON HALL
FAIRBANKS ST
WASHINGTON SQUARE
ALLSTON ST
WARREN ST
BRIGGS ST
HARVARD AVE
PLEASANT ST
BABCOCK ST
FORDHAM RD
ST. MARY'S ST
BLANDFORD ST
B.U. EAST
B.U. CENTRAL
HYNES/ICA
CHARLES RIVER
SCIENCE PARK
MISSION PARK
RIVERWAY
BACK OF THE HILL
Jamaica Pond
Arnold Arboretum
Arboretum
Faulkner Hospital
Roslindale Square
Hyde Park Ave
Cummins Hwy
Harambee Park
Peabody Loop
Franklin Park Zoo
Grove Hall
Blue Hill Ave
Morton St
Walk Hill St
Harvard St
Centre St
South St
Washington St
Beech St
Stony Brook Reservation
Roslindale Ave
Belgrade Ave
Metropolitan Ave
Fairmount Line
Readville
Hancock Village
Putterham Circle
Golf Course
Chestnut Hill
Hammond Pond
Hammond Pond Pkwy
Hammond St
Newton St
Boylston St
Beacon St
Reservoir Rd
Chestnut Hill Ave
Lee St
Warren St
Cottage St
Pond St
Goddard Ave
Larz Anderson Park
Allandale St
Clyde St
Lagrange St
Corey St
Weld St
VFW Pkwy
West Roxbury Pkwy
Baker St
Bourne St
Brookline St
Hartman Rd
Dudley Rd
Langley Rd
Cypress St
Ward St
Centre St
Commonwealth Ave
Kenrick St
Newton Commonwealth Golf Course
Hammond Reservation
Hammond Pond Pkwy
Chestnut Hill Mall
Oak Hill Pond
Oak Hill Pkwy
Dedham St
Needham St
Oak Hill
Cutler Park
Rivermoor Industrial Park
VA Hospital
Riverside Dr
Greendale Ave
Great Plain Ave
Hunting Rd
Manning St
Webster St
Highland Ave
Cedar St
Chestnut St
Rosemary Lake
Needham Country Club
Dedham Ave
South St
Exit 17
Exit 18
Exit 19
Exit 20
Exit 21
Exit 22
Exit 24
Exit 25
Mass Turnpike
Soldiers Field Rd
Western Ave
Arsenal Mall
Arsenal St
Nichols Ave
Grove St
Arlington St
Mount Auburn St
Watertown Yard
Express to Boston via Massbike
Express to Boston via Mass Pike
Fayette St
Mass. Ave.
Franklin St
Centre St
Walnut St
Waltham St
Crafts St
Chapel St
Adams St
Washington St
Watertown St
Pleasant St
Elm St
River St
Lowell Ave
Highland Ave
Austin St
Mill St
Homer St
Cabot Rd
Edmand's Park
Allison Pond
California St
Newton Centre Pond
Crystal Lake
Cold Spring Park
Beacon St
Commonwealth Ave
Woodland Golf Course
Golf Course
Dunbarton Rd
Cedar St
Hemlock Rd
Winchester St
Lincoln St
Parker Rd
Forest St
Hunnewell St
Wellesley Ave
Central Ave
Great Plain Ave
Marked Tree Ln
Nehoiden St
Rosemary Lake
Needham Heights
Needham Center
Needham Junction
Hersey
Wellesley Country Club
Weston Rd
Roberts
Deaconess Waltham Hospital
Hotel Auburndale
Auburndale
Wellesley Farms
Lexington St
Woodward St
Chestnut St
Elliot St
Oak St
Boylston St
Linden St
Cherry St
Temple St
Fuller St
Pine St
High St
Maple St
Ash St
Woodward St
Lowell St
Pearl St
Prospect St
Cherry St
Summit Ave
Harvard St
Walnut St
Mill St
Winchester St
Dedham St
Needham St
Webster St
Manning St
Hunting Rd
Greendale Ave
Great Plain Ave
Dedham Ave
South St
Chestnut St
Rosemary Lake
Needham Country Club
Hersey
Needham Junction
Needham Center
Needham Heights
Wellesley Country Club
Wellesley Farms
Auburndale
Hotel Auburndale
Roberts
Deaconess Waltham Hospital

SOUTHWEST CORRIDOR

Southwest Corridor Outer Area

The Providence commuter rail line is the central feature of the Southwest Corridor. Almost all considered improvements in the outer area, as well as the inner area, utilize directly or relate to the Providence Line in some manner. It has been electrified for use by Amtrak Acela trains, is designed and built for the highest speeds in the MBTA system, and has three tracks in key sections.

Providence Commuter Rail Line Extension to T.F. Green Airport

The completion of the Pawtucket layover facility, located in and funded by the state of Rhode Island, has made possible the expanded commuter rail service to Providence. Rhode Island is now in the process of building a new commuter rail station near the T. F. Green Airport. When complete, this will allow trains that now terminate in Providence to serve the airport, and perhaps more distant stations at some point. The T.F. Green stop would serve commuters to Boston and Providence, as well as air travelers.

Commuter Rail Service to Fall River and New Bedford

Establishing commuter rail service to Fall River and New Bedford is currently under study by the Executive Office of Transportation and Public Works. Several possible alignments are under consideration. Extension of the Stoughton branch of the Providence Line through Easton, Raynham, and Taunton, and then branching to Fall River and New Bedford, is one possibility. Branching from the Providence Line south of Mansfield and approaching Taunton from the west is another option. Service via the Middleborough Line is also being considered; it is the one alignment that does not utilize the Providence Line.

Franklin Commuter Rail Line Extension and Related Improvements

Several expansions and improvements have been proposed for the Franklin commuter rail line. Extending some Franklin Line service along a lightly used freight line is contemplated as a possible way to expand service to Milford and beyond. A station and layover facility in Bellingham could be built as part of this extension.

Currently a branch of the Franklin Line operates from Walpole Station to Foxborough, serving Gillette Stadium on days with home football games. Expansion of weekday service to Foxborough for commuters would be another way of increasing utilization of the Franklin Line.

In order to provide additional capacity on the existing service, it would be beneficial to double-track the Franklin Line near Readville, where the Dorchester Branch converges with the Northeast Corridor (NEC) for a short single-tracked stretch.

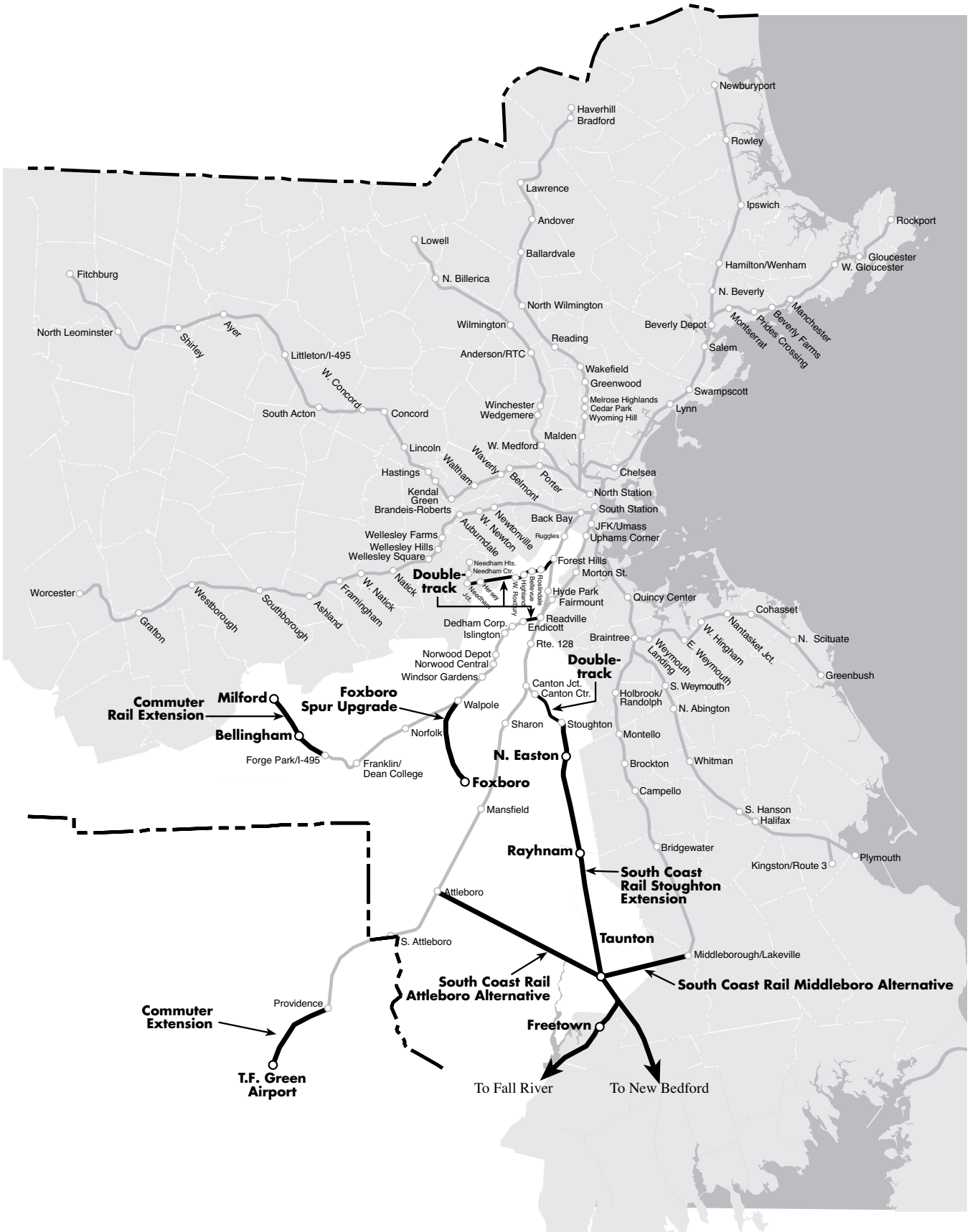
Stoughton Line and Needham Line Capacity Enhancements

Currently the Stoughton Line and the Needham Line have single-track sections between Canton Center and Stoughton (approximately 4.5 miles) and between the Plains Interlocking and Needham (approximately 8 miles), respectively. Double-tracking these sections would facilitate increased service on these lines.

Bus System Improvements

The outer portion of the Southwest Corridor has a number of low-density and lightly served areas in which demand-responsive or fixed-route services could be developed through partnerships with other service providers, municipalities, or the Boston Region MPO to complement existing and potential MBTA services.

MAP 6-10
Southwest Corridor Outer Area Potential Improvements



Southwest Corridor Inner Area

Fairmount Commuter Rail Line Improvements and Possible Extension

This project would upgrade service on the Fairmount commuter rail line by adding new stations on the existing route and by increasing the frequency of service. Currently four new stations are envisioned in Boston neighborhoods, interspersed with existing stations. Approximate locations under consideration include Blue Hill Avenue near Mattapan Square, Talbot Avenue, Washington Street in Dorchester, and Newmarket Square adjacent to the expanding South Bay shopping center and connecting with the planned Urban Ring.

After upgrading Fairmount service, extension of service from the present terminus in Readville to Route 128 Station in Westwood could be considered. This would entail adding a third track within the right-of-way corridor. Adding this track as part of Fairmount service extension would also add capacity and operational flexibility to the highly utilized Providence Line.

Increasing peak-service frequency or extending service to Route 128 would require additional rolling stock, and introducing advanced diesel-multiple-unit (DMU) equipment would be considered. Another possible improvement advocated by community groups would be adding a fifth new station in the context of more frequent, rapid-transit-type service.

Orange Line Extension to Route 128

This project would extend Orange Line service from Forest Hills Station in Boston to Route 128 via the Providence commuter rail line right-of-way. This would be a 6.4-mile extension, including three stations in Boston neighborhoods, terminating at the existing Route 128 park-and-ride station. This segment of the rail line is already fully grade-separated. Some reconfiguration of the tracks would be needed to allow for two Orange Line tracks in addition to railroad tracks. Commuter and intercity rail passenger service on this line would continue.

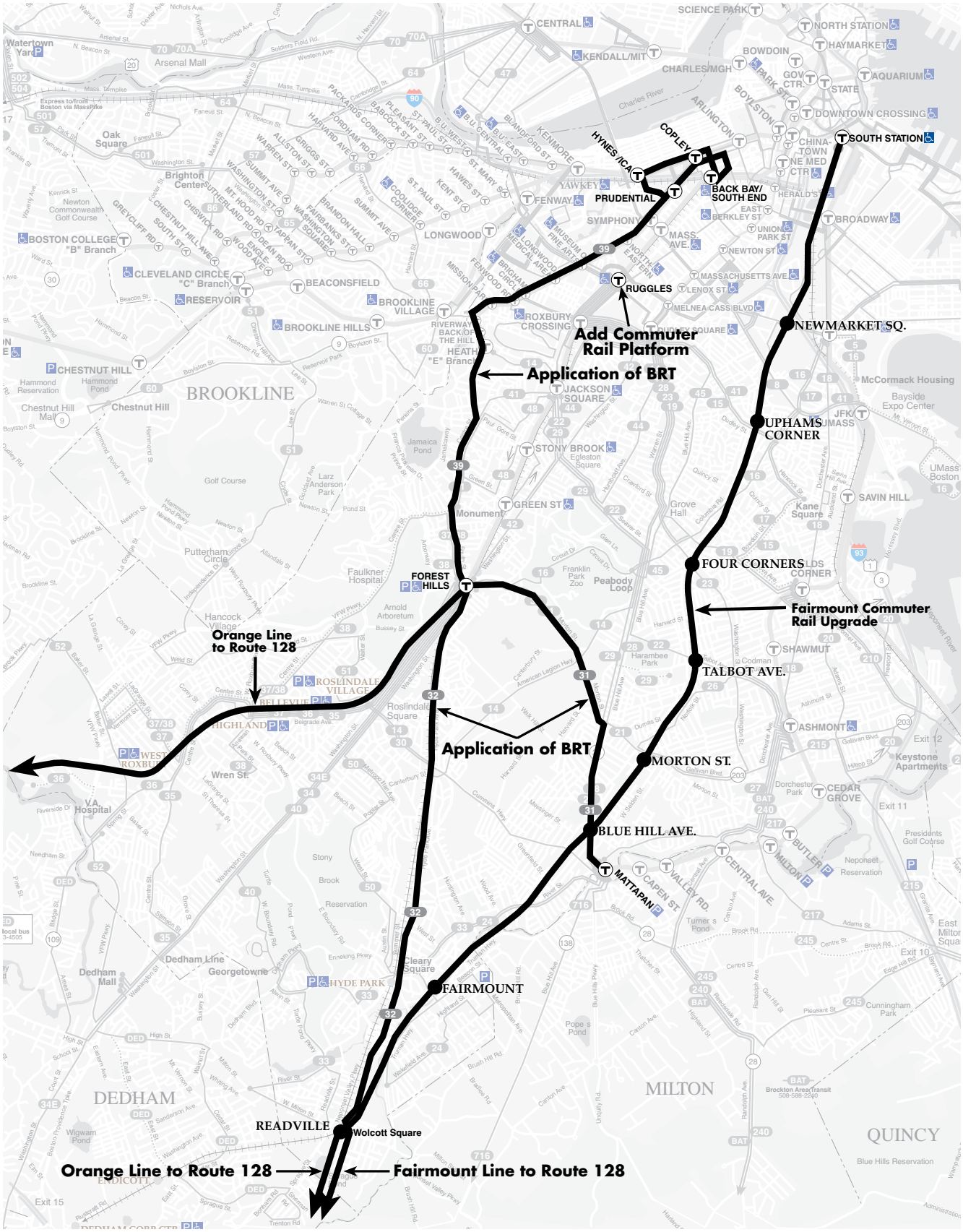
Second Commuter Rail Platform at Ruggles Station

This project would construct a second commuter rail platform at Ruggles Station to allow commuter trains to serve passengers using any of the three available commuter rail tracks. Today, only two of the Ruggles Station commuter rail tracks have access to the station platform. The design would require the use of a small part of adjacent property owned by Northeastern University. The recommended design would simplify the MBTA's operations by increasing service flexibility and reliability while also stimulating ridership.

BRT Elements on Bus Routes 23, 28, 31, 32, and 39

The PMT envisions that across the MBTA system there are opportunities to improve key existing bus routes through the application of BRT features and technologies. Bus Routes 31, 32, and 39 are heavily used routes connecting Forest Hills with Mattapan, Wolcott, and Copley Squares. BRT improvements could include signal priority for buses, dedicated lanes, and stop consolidation. Equipment and services in the Mattapan High Speed Line corridor could also be considered. See the Southeast Corridor Inner Area section for a discussion of Routes 23 and 28.

MAP 6-11
Southwest Corridor Inner Area Potential Improvements



SOUTHEAST CORRIDOR

Southeast Corridor Outer Area

Middleborough Commuter Rail Line Extension and Improvements

The outer area of the Southeast Corridor gained commuter rail service to Middleborough/Lakeville and Plymouth/Kingston in 1997, and to Greenbush in Scituate a decade later. As travel demand in southeastern Massachusetts has gradually increased, extension of the Middleborough Line has been considered. Commuter rail service could be extended along an existing rail freight line from the end of the Middleborough Line to Wareham, an end point relatively convenient to Cape Cod via the Bourne Bridge.

Another possible service enhancement on the Middleborough Line would be adding a new station in West Bridgewater. This station would be near East Bridgewater and would serve both communities.

Old Colony Capacity Enhancements

Possible future service expansion on the three Old Colony Lines—Middleborough/Lakeville, Plymouth/Kingston, and Greenbush—is currently constrained by sections of single track that could be double-tracked. These include approximately 12 miles from South Station to Braintree on which all three Old Colony Lines share operations; around 24 miles on the Middleborough/Lakeville Line between Braintree and Lakeville; 22 miles on the Plymouth/Kingston Line between Braintree and Plymouth; and approximately 17.5 miles on the Greenbush Line between Braintree and Greenbush.

MAP 6-12
Southeast Corridor Outer Area Potential Improvements

Southeast Corridor Inner Area

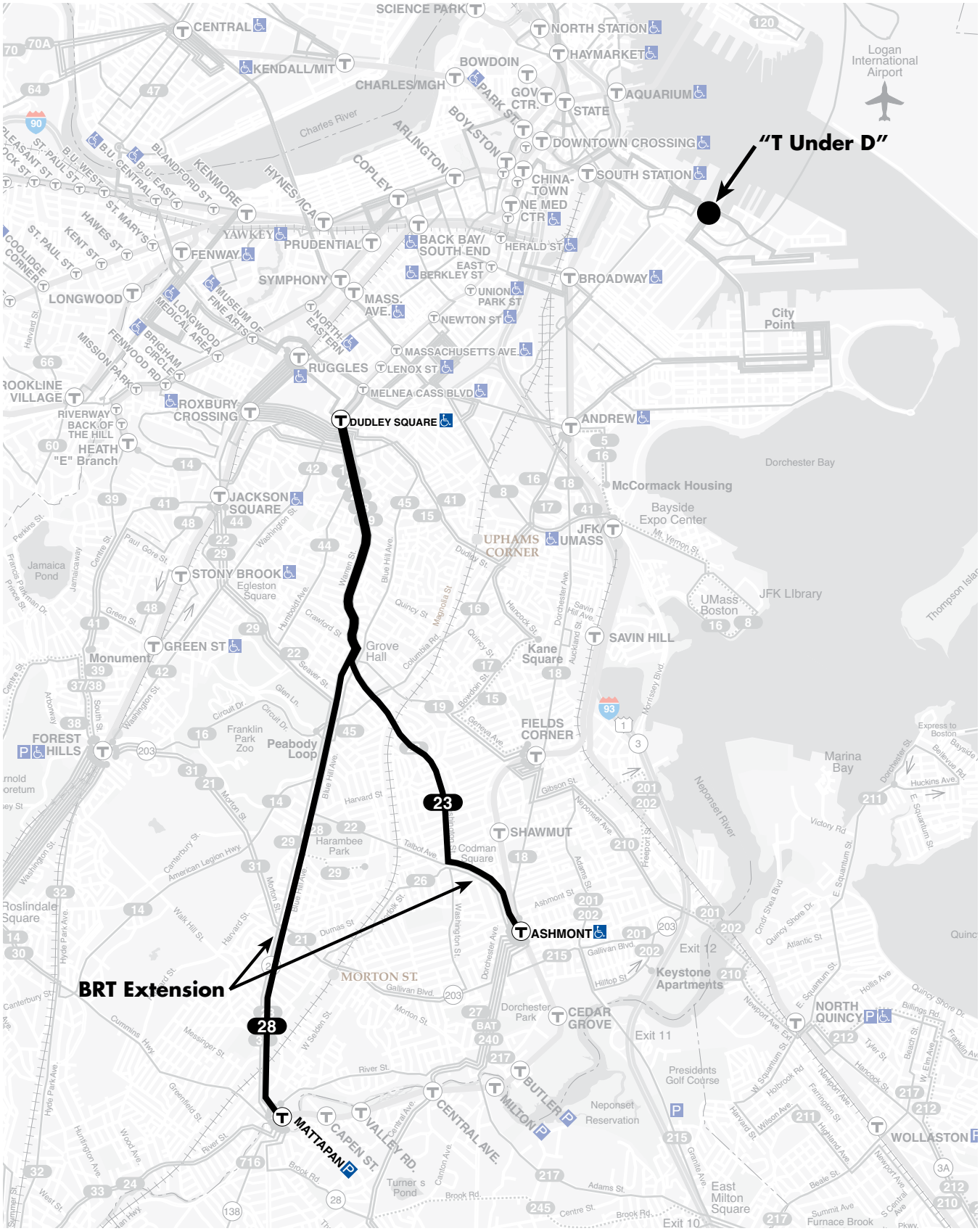
BRT Elements on Bus Routes 23 and 28

The PMT envisions that across the MBTA system there are opportunities to improve key existing bus routes through the application of BRT features and technologies. Bus Routes 23 and 28 are heavily used routes that start at Ruggles Station and travel through Dudley Station to Ashmont and to Mattapan Stations, respectively. Various BRT-related improvements could be made, including signal priority for buses, dedicated lanes, and stop consolidation to better serve the large transit-dependent population in the Southeast Corridor.

Silver Line Waterfront "T Under D"

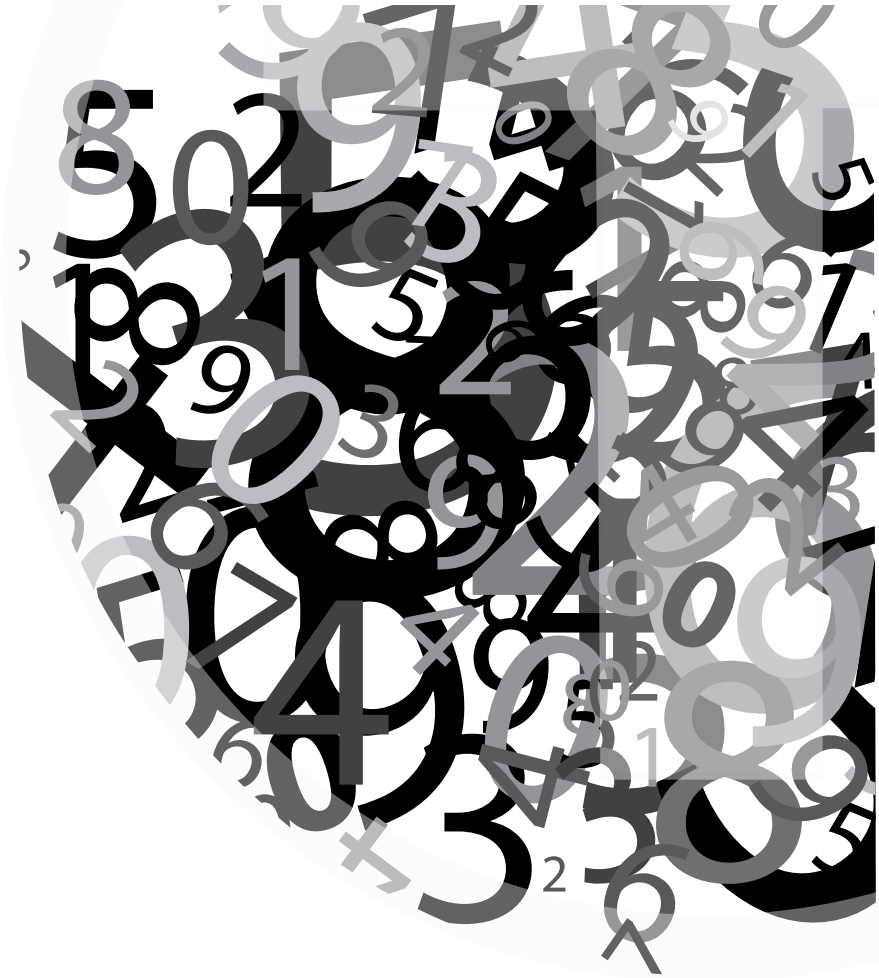
This project would grade separate the Silver Line in the South Boston waterfront by extending the existing tunnel from World Trade Center Station under D Street, allowing the buses to avoid the stoplight at the top of the portal. The T under D tunnel would improve on-time performance and reduce travel time for the SL1 and SL2 routes that serve Logan Airport and the Boston Marine Industrial Park, respectively.

MAP 6-13
Southeast Corridor Inner Area Potential Improvements



CHAPTER 7

Illustrative Scenarios



As mentioned in Chapter 3, this PMT presents and evaluates three scenarios—state-of-good-repair (SGR), enhancement, and expansion—that illustrate possible capital investment strategies based on different approaches to future transit infrastructure improvements and different levels of investment. The nature of these scenarios and the evaluation results are set forth in this chapter. As an illustrative exercise, the scenarios, although they include specific projects, do not represent a recommendation of specific projects. Rather, they show how progress toward meeting the stated objectives of the PMT, as measured through the evaluation criteria, might be achieved by 2030. The comparison of the three scenarios is intended as a guide to decision makers in defining the anticipated trade-offs involved in selecting among alternative future investments.

All three scenarios are evaluated using the Boston Region Metropolitan Planning Organization (MPO) regional travel demand model. This computer model incorporates the demographic and land use projections that were developed by the Metropolitan Area Planning Council (MAPC). These projections assume that, by 2030, development has been concentrated in urban hubs to support the use of transit and other alternative transportation modes. For the 63 municipalities that are in the MBTA sevice area, but outside of the 101 cities and towns in the MAPC region, demographic and land use projections from neighboring MPO's and regional planning agencies are used in the model. Factors such as future changes in gasoline prices or technology advances cannot be reliably known and hence are not incorporated into travel model projections, adding a degree of uncertainty to the projections. However, even allowing for a wide range of future outcomes, the demands placed on the MBTA in 2030 are anticipated to be substantially greater than they are today.

In addition to the illustrative scenarios discussed in this chapter, project-level analysis was also completed for enhancement and expansion projects. The results of this project-level analysis can be found in Appendix I. It is hoped that the project-level analysis will be of use to decision makers when weighing the pros and cons of specific projects.

DESCRIPTION OF SCENARIOS

The SGR Scenario

The 2030 state-of-good-repair illustrative scenario assumes that any deficiencies in the current capital plant, both fixed and mobile, would be corrected, and that any capital element that reaches end-of-life between 2008 and 2030 would be replaced (the requirements for achieving SGR are discussed in Chapter 5). This scenario also assumes that all station accessibility projects have been completed, removing barriers to persons with disabilities. In addition, when making future SGR projections using the travel demand model, it is assumed that the existing system would provide the capacity required to handle projected future ridership without service enhancement or expansion.

The Enhancement Scenario

The enhancement illustrative scenario assumes that all of the work included in the SGR scenario has been performed. Beyond achieving a state of good repair, this scenario also includes a package of infrastructure investments that would enhance existing transportation assets to achieve better speeds, frequencies, and reliability (see Table 7-1). This scenario incorporates some, but not all, of the enhancement project proposals discussed in Chapter 6; all of the corridors receive benefit from its package of projects.

TABLE 7-1
Enhancement Illustrative Scenario: Component Projects

Project	Corridor
BRT elements on Route 1: Harvard–Dudley	Northwest
BRT elements on Route 22: Ashmont–Ruggles	Circumferential
BRT elements on Route 31: Mattapan–Forest Hills	Southwest
BRT elements on Route 32: Wolcott–Forest Hills	Southwest
BRT elements on Route 39: Forest Hills–Back Bay	Southwest
BRT elements on Route 57: Watertown–Kenmore	West
BRT elements on Route 66: Harvard – Dudley	Circumferential
BRT elements on Route 71: Watertown–Harvard	Northwest
BRT elements on Route 73: Waverley–Harvard	Northwest
BRT elements on Route 77: Arlington Heights–Harvard	Northwest
BRT elements on Route 111: Woodlawn–Haymarket	Northeast
Alewife access busways	Northwest
Assembly Square Orange Line station	North
Improved Orange Line frequencies	North
Fitchburg Line improvements	Northwest
Worcester Line service expansion	West
Yawkey Station upgrade	West
Ruggles Station platform expansion	Southwest
1,000 new park-and-ride spaces	Systemwide

MBTA Park-and-Ride lot at Oak Grove Station

A primary focus of the enhancement scenario is implementation of bus rapid transit (BRT) elements in major travel corridors that are currently served by MBTA Key Routes. These projects are designed to improve service for the MBTA's core constituents, who live in the most densely developed parts of the service area and rely on bus service for mobility, as explained in Chapter 6.[1]

The Expansion Scenario

The expansion illustrative scenario assumes both that all of the components of the SGR and enhancement scenarios have been fully implemented. In addition, the expansion scenario assumes enlargement of the system through investment in a number of major expansion projects—BRT, rapid transit, and commuter rail—that would improve connectivity and capacity, and would enhance mobility in the region by filling gaps in existing transit services (see Table 7-2). This scenario incorporates some, but not all, of the expansion project proposals discussed in Chapter 6; all of the corridors receive benefit from its package of projects.

TABLE 7-2
Expansion Projects in Illustrative Scenario

Project	Corridor
Dudley South BRT on Routes 23 and 28	Southeast
Silver Line Phase III	Central
Urban Ring	Circumferential
Green Line to Medford	Northwest
Red–Blue Connector	Central
Blue Line extension to Lynn	Northeast
Plaistow extension of Haverhill Line	North
Nashua/Manchester extension of Lowell Line	North
Fairmount Line improvements	Southwest
T.F. Green extension of Providence Line	Southwest
South Coast Rail to Fall River and New Bedford	Southwest

MODELING RESULTS FOR ILLUSTRATIVE SCENARIOS

Meeting anticipated 2030 demand for transit poses a significant challenge for the MBTA. Today, it is estimated that transit vehicles are boarded approximately 1,220,000 times each day in the region. Accounting for transfers, this translates to about 870,000 daily person-trips (linked trips) and a current transit mode share of 7%. Table 7-3 compares the performance of the existing transit system with the model projections for the three illustrative scenarios. For the enhancement and expansion scenarios, results are presented as a range of outcomes, due to uncertainty regarding the final alignments and service plans for some of the projects included.

1 As discussed in Chapter 6, routes that would duplicate Urban Ring or other expansion projects are modeled at their current service levels in the enhancement scenario. These include Key Routes 15, 23, 28, and 116/117, as well as non–Key Routes 86 and 89. See the Systemwide Projects section of Chapter 6 for full discussion.

TABLE 7-3
Comparison of Illustrative Scenarios

Measures	2008 Base Year	2030 SGR Scenario	2030 Enhancement Scenario Change from SGR		2030 Expansion Scenario Change from SGR	
			Lower Range	Upper Range	Lower Range	Upper Range
Passengers systemwide (linked trips)	871,250	1,332,500	32,300	43,700	97,800	132,300
Boardings systemwide (unlinked trips)	1,219,750	1,742,500	48,450	65,660	146,700	198,450
Trips diverted from auto mode			27,200	36,800	83,100	112,500
Transit mode share	7.00%	7.50%	0.19%	0.25%	0.54%	0.73%
Weekday vehicle miles travelled (VMT) on the transportation system (transit + auto)	104,655,000	125,655,000	136,940	185,270	-425,000	-575,000
Average transit trip travel time (in hours)		0.20	-0.0030	-0.0041	0.0025	0.0033
Kilograms of CO_2 (transit + auto)	59,590,557	71,547,957	-140,470	-190,050	-218,370	-295,440
Kilograms of CO (transit + auto)	315,250	378,270	-2,200	-2,980	-3,410	-4,610
Kilograms of VOC (transit + auto)	21,256	25,414	-70	-90	-100	-140
Kilograms of NOx (transit + auto)	20,988	24,159	-100	-130	230	310
Kilograms of PM 2.5 (transit + auto)	1,329	1,596	-5	-7	-6	-8
Kilograms of PM 10 (transit + auto)	2,868	3,443	-11	-15	-14	-18

Under the SGR scenario the travel demand model projects about 1,330,000 daily person-trips on the MBTA in 2030, an increase of over 50% (about 460,000 daily person-trips) from 2008 levels. This increase in ridership is accompanied by an increase in transit mode share from 7% in 2008 to 7.5% in 2030. Although transit ridership and mode share would increase, total VMT on the transportation system would also increase, causing increases in air pollutants, including a 20% increase in CO_2 emissions.

Under the enhancement illustrative scenario the travel demand model estimates a 2030 transit ridership increase of 2.4% to 3.3% over the level projected for the SGR scenario. The average length of a transit trip would decrease between 1% and 2%, and transit mode share would increase by between 0.19% and 0.25% to as high as 7.75% in 2030. Weekday vehicle miles traveled (VMT) would decline by between 0.11% and

0.15% below SGR levels as drivers switched to the improved transit system. Levels of air emissions would also decrease in proportion to the lower levels of VMT, as compared to the SGR scenario. Although VMT and emissions would be lower than projected in the SGR scenario, they would increase substantially above 2008 levels due to growth in auto trips.

The model predicts that, as compared with the SGR scenario, the expansion scenario would have a significantly greater impact on the transportation system than the enhancement scenario alone. It is estimated that if the expansion scenario (which includes all the enhancement projects) were implemented, transit ridership would increase by 7.4% to 9.9% above projected SGR levels. It should be noted that the Red-Blue connector, the Green Line extension to Medford, and the Routes 23 and 28 Silver Line extension all attract significant new transit ridership, yet actually reduce total transit boardings. This is because these projects improve connectivity and greatly reduce transfers. Unlike the enhancement scenario, the expansion scenario shows average transit trip travel times increasing above SGR levels. This is not necessarily a negative result, as the improved transit connections might allow riders to make longer trips.

Under the expansion scenario, transit mode share would increase over SGR levels by between 0.54% and 0.73% to a potential high of 8.23% in 2030. Weekday VMT would decline by between 0.34% and 0.46% below SGR levels, and air emissions would decrease accordingly. However, as with the enhancement scenario the resulting levels of VMT and emissions would still increase substantially above 2008 levels due to growth in auto trips. In the SGR scenario, CO_2 emissions are projected to rise by 20% above 2008 levels; in both the enhancement and expansion scenarios, CO_2 levels would increase by slightly less than 20%.

As discussed in Chapter 3, the PMT is being coordinated with "You Move Massachusetts," the long-range transportation-planning process of EOT, which is currently underway. Owing to the MBTA's current fiscal constraints, in order to support and advance implementation of major expansion projects in the future, the Authority will rely on discretionary federal grant funding and Commonwealth funding administered through EOT. Therefore, additional analysis of expansion projects that will be completed by the state, including cost estimation, will be performed in the context of the EOT planning process.

MEETING THE EVALUATION TARGETS

Chapter 3 presented the evaluation targets established for quantifiable PMT objectives. These included targets for increased ridership, decreased transit trip travel time, and reduced levels of CO_2 emissions from the transportation sector. All three of the illustrative modeling scenarios show ridership increasing significantly more than the target level of 1% per year growth, or 250,000 additional boardings per day in 2030. The goal of a 2% reduction in average travel time per transit trip was achieved in the enhancement scenario, but not in the expansion scenario. However, as explained above, longer trips might be attributed to better transit connections under the expansion scenario.

The SGR scenario shows a large increase in CO_2 emissions over current levels. Although the enhancement and expansion scenarios show lower CO_2 emissions than the SGR scenario, the contribution of the transportation sector to CO_2 emissions would remain significantly higher than 2008 levels. As discussed in Chapter 3, transit improvements alone, in isolation from the regional transportation network, cannot achieve the very ambitious greenhouse gas reduction targets adopted by the Commonwealth. Transit improvements must be implemented in the context of an overall land use–transportation strategy that fosters changes in travel behaviors, improves intermodal connections, increases system capacity, and puts in place incentives for energy conservation and green technology.

Appendix A Northeast Corridor: Mobility Problems and Proposed Solutions

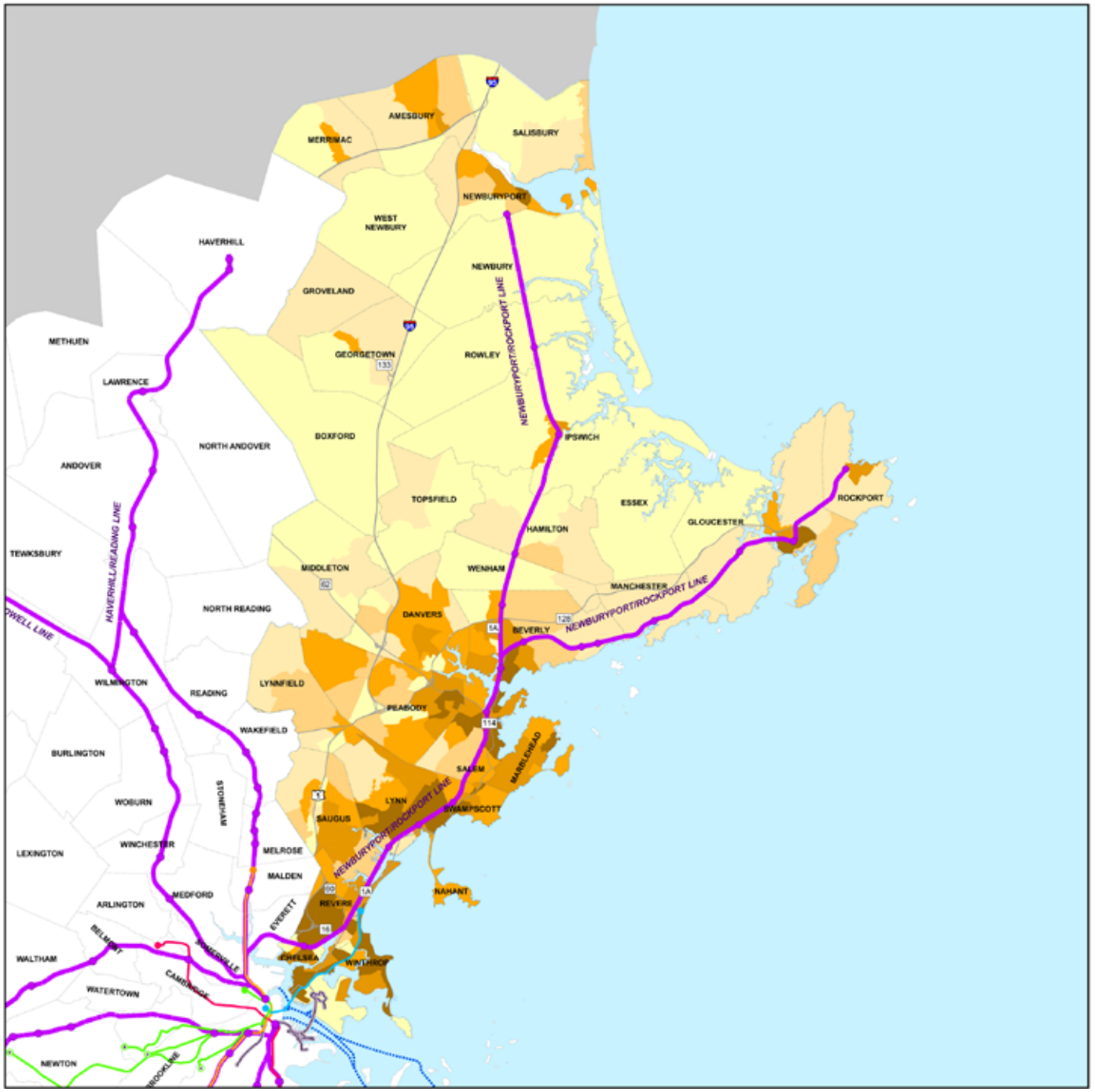
BACKGROUND

Existing Conditions

The Northeast Corridor extends from the Boston Harbor to Merrimac, Amesbury, and Salisbury bordering New Hampshire north of the Merrimack River. The corridor includes eight cities, 24 towns, and East Boston (a neighborhood of Boston), including Logan Airport. In the Northeast Corridor is found the historic factory city of Lynn, as well as the maritime communities of Salem, Marblehead, Beverly, Gloucester, and Newburyport. Large swaths of the corridor north of Cape Ann are protected marine estuaries.

The MBTA offers rapid transit, bus, and commuter rail services across much of this corridor. The Blue Line has eight stations from Maverick Square in East Boston to Wonderland in Revere. The Blue Line also has a stop serving Logan Airport, from which dedicated free Massport shuttle buses circulate to all air terminals. MBTA Blue Line service to Logan Airport has recently been supplemented by the popular Silver Line bus rapid transit service from South Station.

Maverick and Wonderland Stations both serve as major bus hubs, though some important services operate from other stations, notably buses to Winthrop from Orient Heights operated by Paul Revere Transportation under contract to the MBTA. MBTA buses also serve the corridor communities of Chelsea, Saugus, Lynn, Swampscott, Marblehead, Salem, Peabody, Beverly and Danvers. Many MBTA buses in this corridor operate all the way to Haymarket Station, in Boston Proper. These routes use the I-90 Ted Williams Tunnel, Route 1A Sumner Tunnel, or U.S. Route 1 Tobin Bridge. Because these routes use the regional express highways, they are able to provide a high level of service.



MAP A-1
Northeast Corridor of the MBTA Service Area

Population Density, 2000

U. S. Census 2000
Population/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 176,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

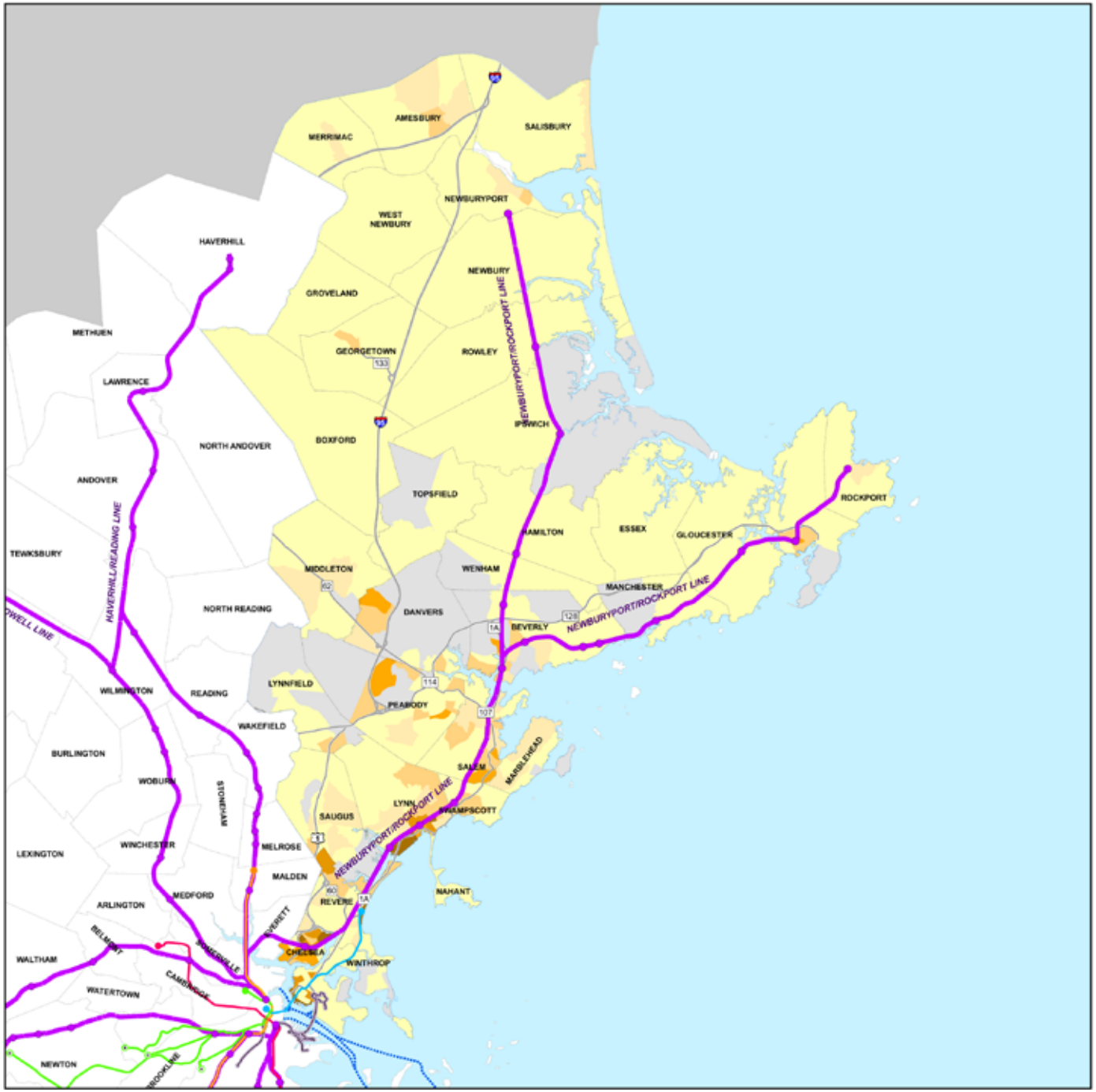
- Commuter rail line

0 2 4 8 Miles

N

MBTA Program for Mass Transportation

March 2008



MAP A-2
Northeast Corridor
of the MBTA Service Area

Projected Change in Population Density from 2000 to 2030

2030 MetroFuture Projection
Change in Population/Sq. Mi. by TAZ

- -4,086 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 164,061

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 1.5 3 6 Miles

MBTA Program for Mass Transportation

March 2008

N

Commuter rail service is operated on the Newburyport and Rockport Lines. Trains of both these lines serve Chelsea, Lynn, Swampscott, Salem, and Beverly. At Beverly one line goes north to Rowley and Newburyport, and one line goes northeast to Manchester, Gloucester, and Rockport. The five municipalities served by both lines enjoy a comparatively higher level of rail service, and are also served by MBTA buses.

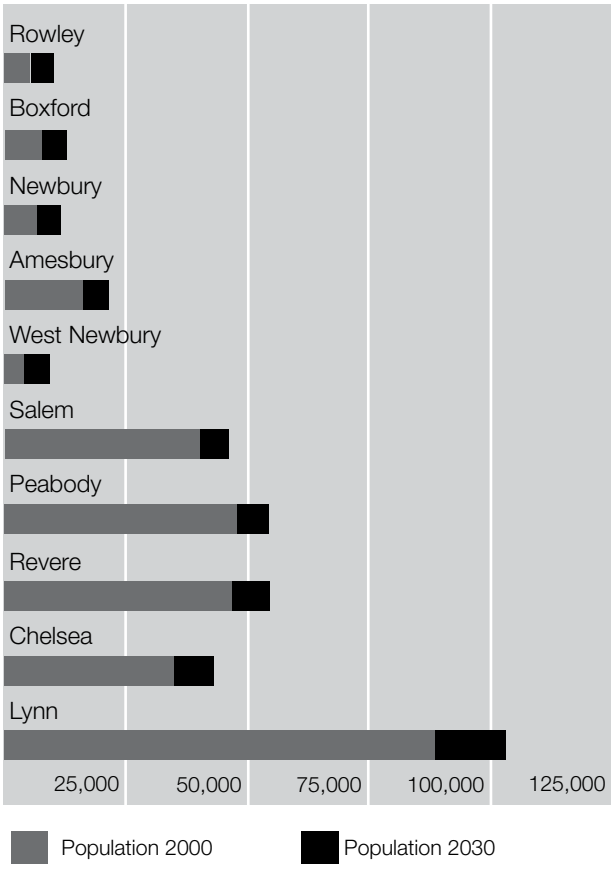
Bus service in the Northeast Corridor is also provided by the Cape Ann Transportation Authority (CATA) and the Merrimack Valley Regional Transit Authority (MVRTA). CATA provides seven bus routes from downtown Gloucester to other points in Gloucester and Rockport, and a Saturday-only route that operates between downtown Gloucester and the Liberty Tree and North Shore Malls in Danvers and Peabody. MVRTA has one year-round route serving Merrimac, Amesbury, and Newburyport, and operates a summer-only route that serves Merrimac, Amesbury, and Salisbury.

Population

The most densely populated corridor communities are concentrated near Boston, mostly inside of Route 128, with the highest densities found in Chelsea, Winthrop, Revere, Lynn, and portions of Beverly, Peabody, and Salem (see Map A-1). Population densities in parts of Chelsea and Lynn are projected to experience the largest increases between 2000 and 2030 (see Map A-2).

According to the U. S. Census, the Northeast Corridor's year 2000 population was 590,368. In absolute numbers, population is projected to increase by 103,629 (18%) to 693,995 by 2030.[1] Almost three-quarters of the communities are projected to experience double-digit population growth. However, the growth for most communities is expected to be fairly moderate, with the most robust occurring in the least populated communities. The city of Lynn was the most populous community in 2000 and is projected to be the most populous in 2030 as well, with Chelsea, Lynn, Peabody, and Revere accounting for more than a third of the corridor's absolute population growth (see Figure A-1).

FIGURE A-1
Northeast Corridor 2000–2030
Population Growth: Top-Ten Communities in Order of Increase



A number of housing developments are currently planned for the corridor. Two of the largest are the Little River Transit Village Transit, a proposed transit-oriented development of 600 units in Newbury/Newburyport, and the proposed Wonderland transit-oriented development of 902 homes in Revere.

Employment

The 2000 census data show that cities and towns within Route 128 have the highest em-

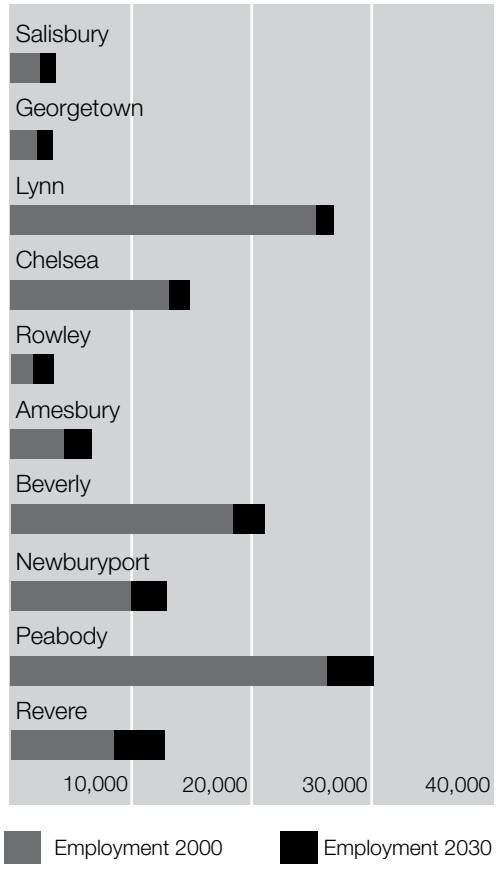
1 Metropolitan Area Planning Council (MAPC) and Merrimack Valley Planning Commission (MVPC) population and employment forecasts.

ployment densities in the Northeast Corridor, while the majority of corridor communities outside Route 128 have low employment densities, with portions of Newburyport and Rockport being the main exceptions (see Map A-3). Most communities in the corridor are projected to experience modest or no employment density changes between 2000 and 2030 (see Map A-4).

In absolute terms, employment in this corridor is projected to increase by 15% between 2000 and 2030, with most communities experiencing stable or modest growth.[2] Of the six corridors, the Northeast shows the lowest level of 2000 employment and is projected to have the lowest absolute employment growth, as well as the lowest rate of employment growth, between 2000 and 2030. Peabody has the highest current level of employment, and the second highest projected growth (14%) by 2030 (see Figure A-2).

Larger proposed employment developments in the corridor include the Little River Transit Village proposed in Newbury/Newburyport with 123,000 square feet of retail and 48,000 square feet of office space, and the Wonderland project, which is now undergoing permitting and will have 42,000 square feet of retail and 145,000 square feet of office space.

FIGURE A-2
Northeast Corridor
2000–2030 Employment Growth:
Top-Ten Communities in Order of Increase

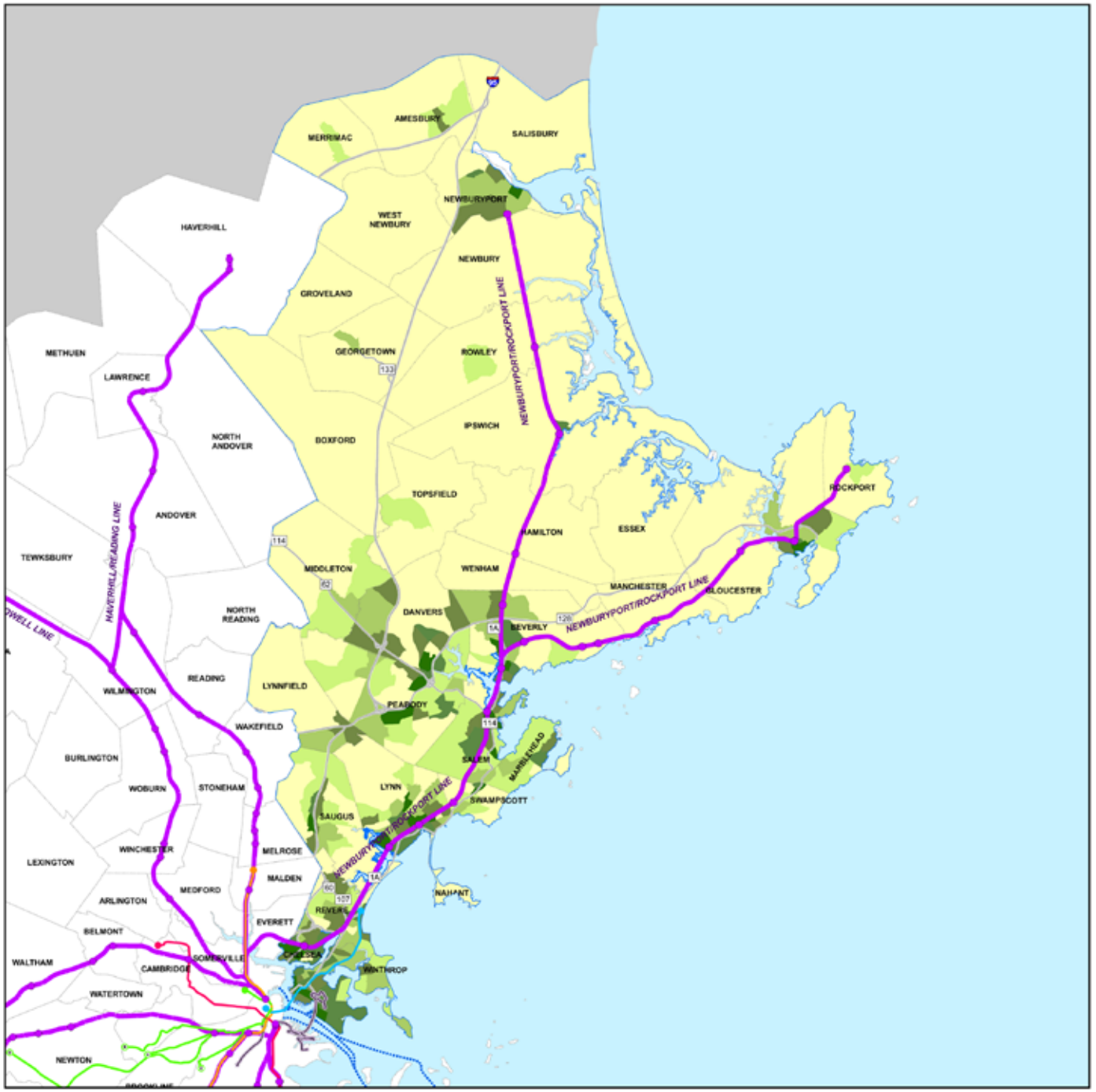


Journey to Work

Nationally, work trips account for a small proportion—15 %—of all trips.[3] Because most commuting occurs during peak travel times, work-trip volumes determine the capacity needs, as well as the performance, of highway and transit systems. In 2000, of all work trips that originated in the Northeast Corridor, 76% were made in single-occupancy vehicles (SOVs), and 8% were made on transit (see Figure A-3).

2 Ibid.

3 Transportation Research Board, *Commuting in America III: The Third National Report on Commuting Patterns and Trends*, NCHRP Report 550, October 2006, p. 3.



MAP A-3
Northeast Corridor of the MBTA Service Area

Employment Density, 2000

2000 CTPS Employment Database
Employees/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 1,000,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

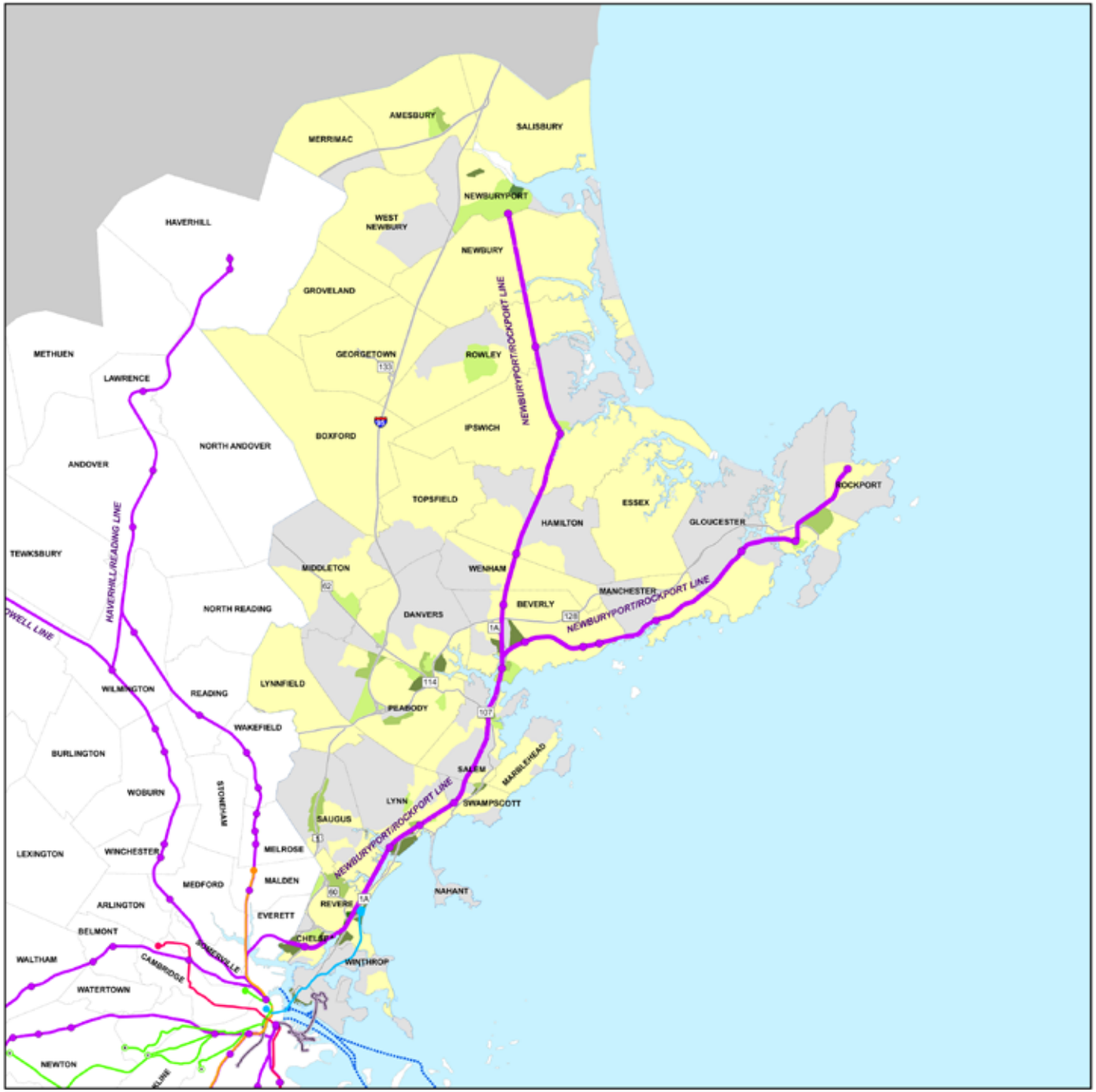
- Commuter rail line
- Special MBTA sporting events

0 1.25 2.5 5 Miles

MBTA Program for Mass Transportation

March 2008

N



MAP A-4
Northeast Corridor of the MBTA Service Area

Projected Change in Employment Density from 2000 to 2030

2030 MetroFuture Projection
Change in Employees/Sq. Mi. by TAZ

- -94,000 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 400,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Mattapan High Speed Line
- Red Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 2 4 8 Miles

N

MBTA Program for Mass Transportation

March 2008

FIGURE A-3
2000 Travel Modes to Work by Northeast Corridor Residents

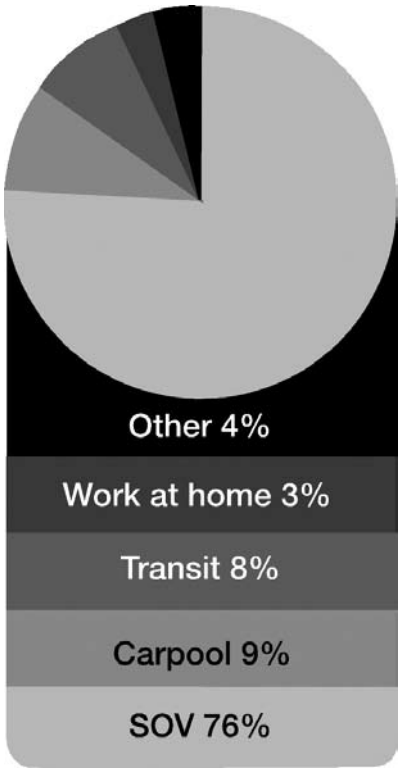
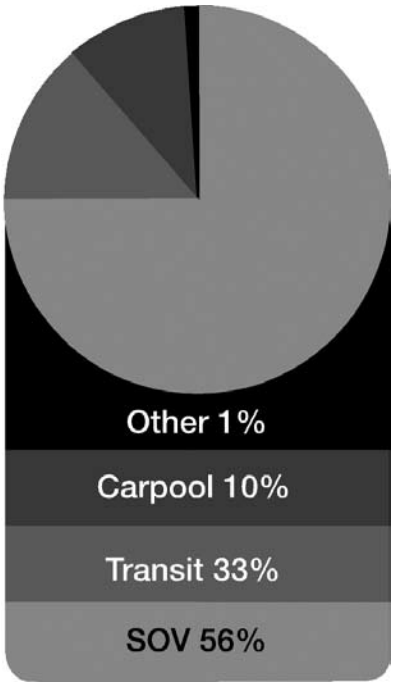


FIGURE A-4
2000 Travel Modes to Work by Northeast Corridor Residents To Boston and Cambridge



Most MBTA service is radially oriented towards Boston and Cambridge, which together are the destination for 18% of the work trips made by corridor residents. Of the work trips from the corridor to Boston and Cambridge, 56% are made in single-occupancy vehicles, and 38% are made by transit (see Figure A-4). Almost half of these corridor work trips to Boston and Cambridge originate in four communities: Chelsea, Lynn, Revere, and Winthrop, all of which are close to Boston.

Traffic Congestion

Interstate 95 is the main radial highway in the Northeast Corridor between New Hampshire and metropolitan Boston. In Peabody, I-95 joins Route 128 and becomes Boston's inner circumferential expressway. Traffic into Boston continues south on U.S. Route 1 and enters Boston over the Tobin Bridge. Route 1A parallels U.S. Route 1 closer to the coastline, connecting the older town centers.

Monitoring shows that peak-period traffic on the section of Route 1 between Peabody and Boston moves at close to the posted speed limits, except at the final entry to Boston over the Tobin Bridge. I-95 north of Route 128 is generally not congested, so typical speeds during peak periods are assumed to be at or above the speed limit.

Route 1A through Revere and East Boston experiences reduced peak-hour travel speeds, especially inbound as it approaches Boston.[4] The MBTA operates a number of express bus

routes from the North Shore that use this section of Route 1A.

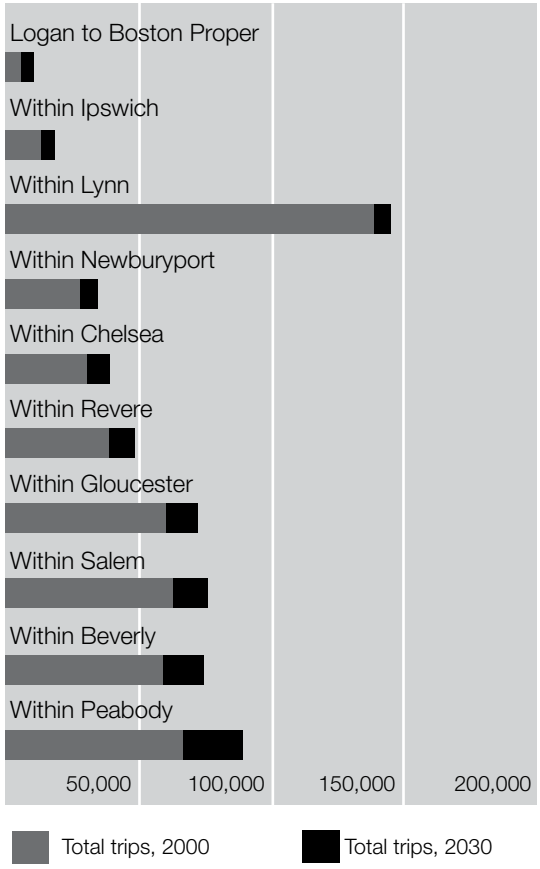
Travel Projections

The CTPS regional travel-demand model provides estimates of current travel volumes and projections of future travel volumes for all major modes: auto, transit, and walk/bike. A useful way of tracking travel growth patterns is to look at the change in travel between pairs of municipalities, to include trips beginning and ending in the same municipality. By 2030, there are projected to be 50 travel pairs in the Northeast Corridor with projected increases of at least 1,000 two-way trips per day. The projected travel volume increase for these 50 pairs is 187,922 trips per day (just over 20%).

The largest projected increases in the corridor are trips made entirely within one community: within Peabody (22,348), within Beverly (15,113), within Salem (13,251), within Gloucester (12,004), within Revere (9,698), within Chelsea (8,633), within Newburyport (6,584), and within Lynn (6,213). (See Figure A-5.)

At present, transit coverage within the Northeast Corridor varies among communities, with those nearest to Boston having the most extensive route networks. Peabody and Beverly, which have the two largest projected travel volume increases in the corridor, are each served by a combination of MBTA and town-sponsored bus routes. Of the rest of the top 15 projected travel volume increases, all but one are projected to be within or between municipalities/neighborhoods that are connected by MBTA bus or rapid transit service, by MBTA-funded bus service, or by Regional Transit Authority (RTA) bus service (Ipswich has no year-round local bus service, but has had town-sponsored summer bus service for several years). These top 15 account for 65% of the projected increases in the corridor. Several of those below the top 15 also have MBTA local service, but some have either no transit service or very limited service.

FIGURE A-5
Northeast Corridor Trip Increases 2000–2030: Top-Ten in Order of Increase



The model also projects that 11 origin-destination pairs will have increases of over 1,000 daily trips between points in the Northeast Corridor and points in other PMT corridors, including 7 routes connecting with the North Corridor, 3 with Boston Proper, and 1 with the Northwest Corridor. The largest of these increases are for trips between Logan Airport and Boston Proper (4,536), and trips between Logan Airport and Cambridge (2,075). The projected increases for the other 9 pairs are below 1,700 for each pair.

Environmental Justice

The federal government defines environmental justice (EJ) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, education level, or income with

4 2004 Congestion Management System (CMS) Report, Central Transportation Planning Staff, December 2004.

respect to the development, implementation, and enforcement of environmental laws. The MBTA monitors EJ through implementation of and reporting for Title VI of the Civil Rights Act of 1964.

The Northeast Corridor encompasses East Boston, a densely populated neighborhood that is comprised of tracts that are classified as minority areas, low-income areas, or both for Title VI. Several other municipalities in the Northeast Corridor—Chelsea, Revere, Lynn, and Salem—contain census tracts that are classified as minority or as both minority and low-income, and Peabody has a tract that is identified as low-income.

Over 30 bus routes operate in this corridor; 14 are classified as minority routes, and 9 are classified as minority and low-income.

The Newburyport/Rockport commuter rail line operates in the Northeast Corridor. Three commuter rail stations in this corridor meet the both minority and low-income criteria.

A portion of the Blue Line runs through this corridor. Six of the Blue Line stations in this corridor meet the minority criterion, and two of these stations meet both the minority and low-income criteria.

MOBILITY PROBLEMS AND PROPOSED SOLUTIONS

Capacity Improvements Are Needed

Investments will be needed to ensure that sufficient capacity Is available to serve current and projected travel demand.

Problem 1:

As indicated above, by 2030 large growth in intracity trips is projected for Peabody, Beverly and Salem, all of which currently have only partial local transit coverage.

Proposed Solutions:

- Strengthen the identity of common service corridors associated with major employment, residential, or other activity hubs by consolidating services, providing real-time customer information, improving amenities, and enhancing bus stop facilities.
- Expand local bus service to West Peabody.

Problem 2:

By 2030, modeling projections suggest that three bus routes in the Northeast Corridor (Routes 110, 111, and 117) will experience passenger crowding levels that would trigger the need for additional service.

Proposed Solutions:

- To increase peak-period capacity and to ensure that future vehicle loads do not exceed safe and comfortable levels, three additional 40-foot buses would be required to operate these three routes. Replacing existing 40-foot buses with 60-foot buses would be another method for increasing capacity to meet demand.
- Create the Urban Ring BRT transitway between Bellingham Square and Wood Island.

Problem 3:

Lynn had the highest number of total intracity trips in this corridor in 2000 (138,747). Although the rate of growth in trips is projected to be relatively small, Lynn would continue to have the most trips within any single municipality in the corridor by 2030. Lynn's transit mode share is, however, comparatively low, despite a robust bus and commuter rail network.

Proposed Solution:

Provide better bus amenities at Central Square, such as real-time customer information, and improve system identity

Problem 4:

Very densely populated areas in Chelsea, which currently generate significant numbers of trips into the urban core, do not have frequent rapid transit access within a reasonable walking distance.

Proposed Solutions:

- Implement BRT service to Bellingham Square in Chelsea from Maverick Station.

- Create the Urban Ring BRT transitway between Bellingham Square and Wood Island.

Problem 5:

Very densely populated areas in Lynn, which currently generate significant numbers of trips into the urban core, do not have frequent rapid transit access within a reasonable walking distance.

Proposed Solution:

Extend the Blue Line to Lynn.

Problem 6:

There are still some capacity constraints on the Newburyport/Rockport commuter rail line that cause delays.

Proposed Solution:

Double-track 0.8 miles through the Salem Tunnel on the trunk portion of the line, almost 15 miles on the Newburyport Branch between North Beverly and Newburyport, and 4 miles between Control Point Wilson in Gloucester and Rockport Station on the Rockport Branch.

Access to MBTA Services Needs to Be Improved

Connections with Other RTAs

Problem:

The Northeast Corridor is served by two Regional Transit Authorities that provide connections to MBTA services. Although an effort was made in the past to coordinate some bus schedules with commuter rail, current services provide few convenient connections.

The Cape Ann Transportation Authority (CATA) operates seven year-round bus routes from downtown Gloucester to other points in Gloucester and to Rockport. All of these routes either originate or stop at a waiting room on Main Street in Gloucester, approximately one-third of a mile from the Gloucester commuter rail station. Two of the seven routes serve Gloucester Station directly on most trips, but do not provide conveniently timed connections to or from trains. Two other routes serve Gloucester Station on selected peak-period trips that were originally scheduled to facilitate easy transfers between buses and trains. However, over time, the bus schedules have not been changed to accommodate changes in commuter rail schedules, so they no longer provide easy connections. One of the routes that serves Gloucester Station also stops at Rockport Station, where several outbound midday trips provide fairly close connections to inbound trains, but not from outbound trains. The other three of the seven routes have no direct service to Gloucester Station. One of these serves West Gloucester Station directly on all trips, several of which connect well with inbound trains, but none of which provide connections from outbound trains.

Although the Merrimack Valley Regional Transit Authority (MVRTA) operates primarily in the North Corridor, one year-round MVRTA route operates in the Northeast Corridor, providing service from downtown Haverhill—about 0.2 miles from the commuter rail station—through Merrimac and Amesbury to downtown Newburyport, where two AM peak-period trips serve Newburyport Station. Both trips provide close connections there to inbound trains and one connects within 21 minutes from an outbound train. In the PM peak, one trip connects from an outbound train, but there is no inbound connection.

Although both the Cape Ann Transportation Authority (CATA) and the Merrimack Valley Regional Transit Authority (MVRTA) serve the Northeast Corridor, current schedules provide few close connections between RTA and MBTA services. In general, RTA bus routes do not function well as commuter rail feeders, as they serve different functions and populations. Most RTA routes provide local service on even headways, while commuter rail provides long-distance commuter service and operates on uneven headways due to a number of equipment and operational constraints. In addition, because RTA routes have frequent stops and many do not provide direct service to stations, using them to access stations is much slower than driving.

Proposed Solution:

Adjusting the RTA services to meet the commuter rail schedules would inconvenience customers making local trips. Changing the commuter rail schedules to coordinate with RTA services would entail significant capital and operating costs without significantly improving service for most commuter rail riders. The best solution, therefore, would be to create RTA feeder services to commuter rail. It is recommended that as demand for commuter rail feeder service increases, the MBTA work with CATA and MVRTA to select one or more stations on commuter rail routes in the corridor and to determine the number and alignment of routes that would be required to provide adequate feeder services.

ADA Accessibility

Problem:

Although the MBTA has made strides toward providing ADA accessibility to all of its services, some gaps still remain. On the Newburyport/Rockport Line, Prides Crossing and Chelsea stations have not yet been made accessible.

Proposed Solution:

Based on the feasibility of construction, Chelsea is a high priority for near-term accessibility improvements.

Station Parking

Problem 1:

Access to rail transit services, for customers of all abilities, is constrained by the availability of parking, both for automobiles and for bicycles. An inventory of station parking that was completed during the fall of 2005 and winter of 2006 shows that parking at the following stations is utilized at 85% of capacity or greater[5] (see Table A-1).

TABLE A-1
Northeast Corridor
Station Parking at 85% Usage or Greater

Line	Station
Newburyport/Rockport	Beverly Depot
	Salem
	Ipswich
	Manchester
	Prides Crossing
	Swampscott
Blue Line	Beachmont
	Suffolk Downs

Proposed Solution:

The MBTA can address inadequate parking capacity either by increasing the number of spaces or controlling demand through measures like raising the price of parking overall or installing automated parking-fee collection at MBTA lots to allow for congestion pricing and to improve enforcement of parking regulations.

When evaluating the potential expansion of parking, the availability of MBTA-owned land, the potential cost of acquiring nearby land, and the potential cost of a multilevel structure are all important considerations. Potential parking expansion projects in the Northeast Corridor include Beverly, Salem, Wonderland, and Rockport.

Problem 2:

For some customers, access to rail services is constrained by the lack of bicycle parking. A recent study provided a detailed inventory of bicycle amenities, by MBTA station, that included the location, number, and condition of bike racks, bike rack shelters, and signage directing cyclists to them. The study also noted that at some stations where bike racks were provided, cyclists did not utilize the racks, but parked their bikes elsewhere.[6]

5 Fijalkowski, Jared, and Ostertog, Heather, *Inventory of Park-and-Ride Lots at MBTA Facilities*, Central Transportation Planning Staff, February 27, 2007.

6 Fijalkowski, Jared, and Yaitanes, Justin, *2005–2006 Inventory of Bicycle Parking Spaces and Number of Parked Bicycles at MBTA Stations*, Central Transportation Planning Staff, October 2, 2007, Table 6.

TABLE A-2
Northeast Corridor Bicycle Parking Improvements

Line	Station	Bicycle Parking Enhancement Recommendation
Blue Line	Orient Heights	Install sheltered racks
	Maverick	Install sheltered racks
	Wonderland	Provide shelter for existing racks
	Wood Island	Provide shelter for existing racks
	Revere Beach	Provide shelter for existing racks
Newburyport/Rockport	Swampscott	Install inverted-U racks near stairs to platforms
	Hamilton/Wenham	Install sheltered racks close to platforms
	Ipswich	Relocate existing racks to sheltered area
	Beverly Depot	Relocate existing racks to sheltered area
	Newburyport	Relocate existing racks closer to platform

Proposed Solution:

The study recommended that the MBTA continue to expand bicycle parking at stations; however, the MBTA does not currently have a standard for determining what the appropriate number of spaces would be for each station. The study therefore also recommended that the MBTA adopt a standard for providing bicycle parking spaces at transit stations.

In instances where bikes were parked at locations other than at bike racks that were provided, the study made recommendations, based on the type of problem observed, including:

- The rack was in an inconvenient location (e.g., far from the platform).
- The rack was not sheltered from the weather.
- The rack was in a secluded location that was difficult to find or might encourage theft.
- The rack was damaged or difficult to use.

The specific improvements shown in Table A-2 are recommended for stations at which existing bike racks were not used.[7]

Infrastructure Enhancements Are Needed

Problem:

In order to continue to maintain and improve service quality as demand grows and as technologies and materials improve, the MBTA would need to continually invest in infrastructure enhancements.

Proposed Solution:

Table A-3 lists some of the enhancement projects that have been identified as future needs.

7 Fijalkowski, Jared, and Yaitanes, Justin, *2005–2006 Inventory of Bicycle Parking Spaces and Number of Parked Bicycles at MBTA Stations*, Central Transportation Planning Staff, October 2, 2007, Table 6.

TABLE A-3
Northeast Corridor Infrastructure Enhancement Projects

Blue Line	
Asset Category	*Project Description*
Facilities	Construct busways on the Route 1A side of Wonderland Station and consolidate parking in a multilevel structure adjacent to Route 1A.
Signals	Evaluate the use of Communication-Based Train Control (CBTC) for the Blue Line.
Newburyport/Rockport Line	
Asset Category	*Project Description*
Facilities	Construct a new commuter rail layover facility in Rockport.
Power	Install ventilation fans at the Newburyport Line layover facility.
Signals	Improve the reliability of the Gloucester Branch signal system on the Newburyport/Rockport Line: replace the track code system, install a power switch, eliminate the pole line, and upgrade the crossing warning systems.
Signals	Upgrade signals from Beverly Junction to Chelsea on the Newburyport Line.

A State of Good Repair Needs to Be Achieved.

Problem:

A number of system preservation projects must be addressed in the short- to mid-term to bring the system into a state of good repair and to ensure the safety of passengers and reliability of service. Some system preservation projects also have the potential to improve service, given technological advances since the original systems were constructed.

Proposed Solution:

Table A-4 lists some of the specific projects needed to bring the system into a state of good repair and maintain it in that condition.

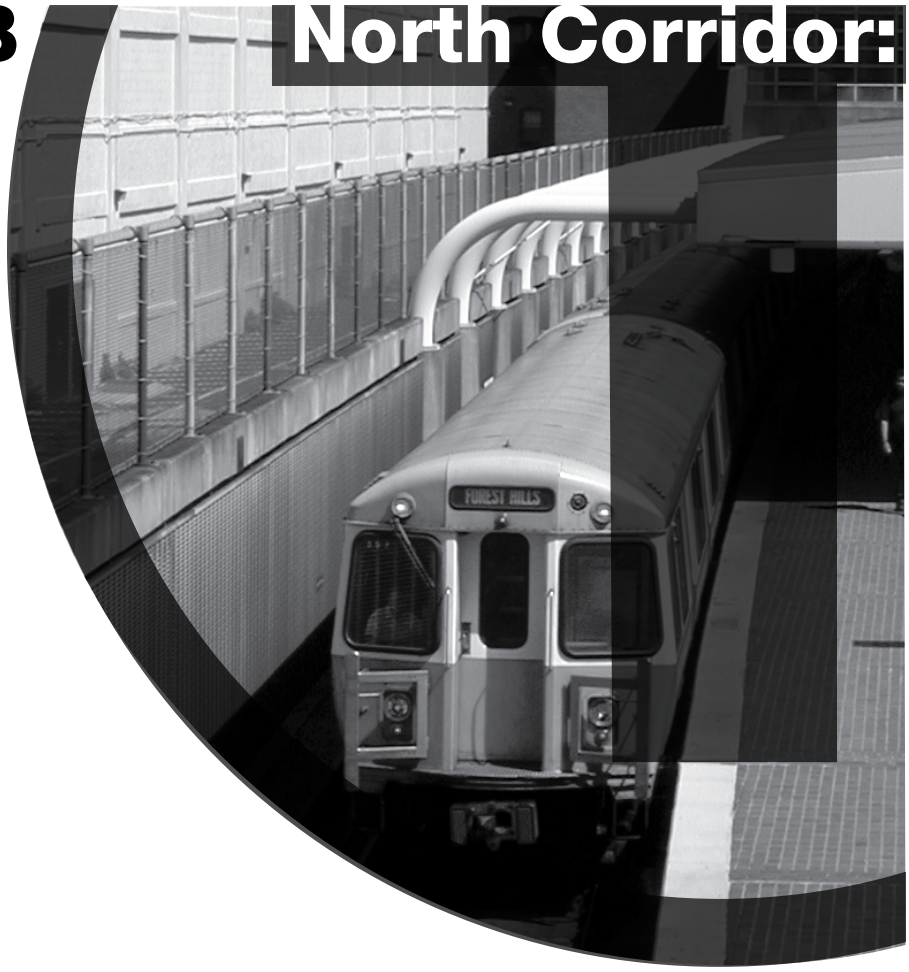
TABLE A-4
Northeast Corridor State-of-Good-Repair Projects

Bus	
Asset Category	*Project Description*
Maintenance/storage facilities	Replace the roof and air conditioning system at the Charlestown bus garage and maintenance facility.
Maintenance/storage facilities	Refurbish the bus storage facility at Lynn garage (bus maintenance functions may be moved to Wellington Station in the North Corridor).
Blue Line	
Asset Category	*Project Description*
Power	Replace all 125-volt DC emergency lighting systems at stations on the Blue Line.
Power	Replace Blue Line passenger station unit substations (one substation being done as part of Blue Line modifications).
Power	Remove existing heavy section insulators and replace them with new, lightweight, state-of-the-art-design double-beam section insulators in Orient Heights Yard on the Blue Line.
Power	Completely replace the OCS system in the Orient Heights Yard, as well as other areas along the Blue Line.
Power	Install two AC cables on the Blue Line from Orient Heights substation to Wonderland substation. Refurbish all substation buildings and replace all the internal operating equipment.
Signals	Replace the outdated signal system on the Blue Line.
Track/right-of-way	Blue Line special track work renewal program to replace turnouts (switches).
Track/right-of-way	Rebuild Blue Line track in the Orient Heights Facility.
Track/right-of-way	Replace worn rail, bolted rail, and ties from Government Center to Orient Heights stations on the Blue Line.
Newburyport/Rockport Line	
Asset Category	*Project Description*
Bridges	Repair one bridge on the Newburyport/Rockport Line that is currently rated as structurally deficient.
Bridges	Upgrade electrical controls for the Beverly Drawbridge.

Appendix B

Mobility Problems and Proposed Solutions

North Corridor:



BACKGROUND

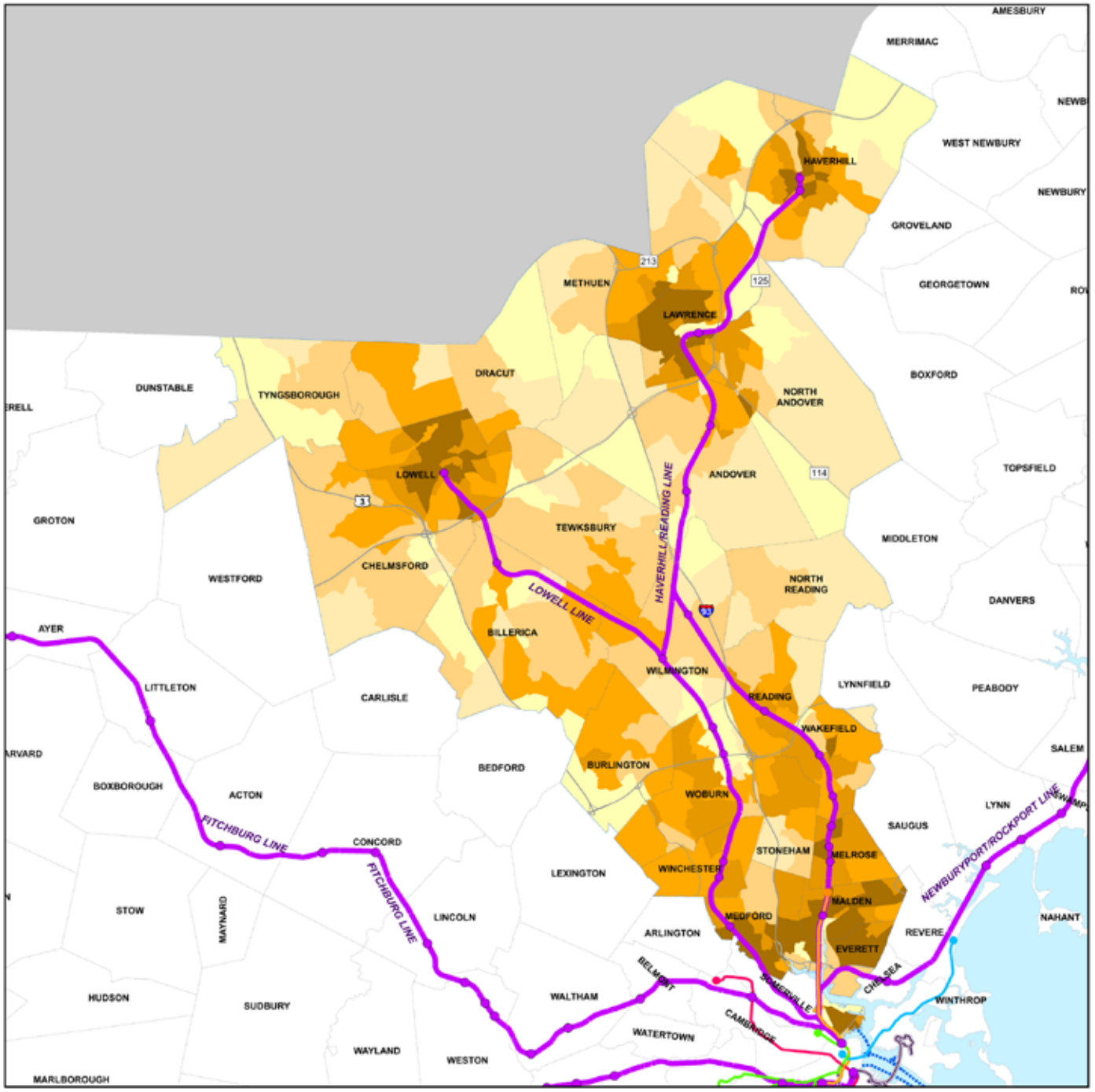
Existing Conditions

The North Corridor extends from the Charles River to New Hampshire. The corridor is anchored in the south by the Boston neighborhood of Charlestown and the densely populated cities of Everett, Malden, and Medford. In the north the corridor includes the three historic Merrimack River mill cities in Massachusetts: Lowell, Lawrence, and Haverhill. Altogether, there are 23 municipalities in the North Corridor.

MBTA services in this corridor include five stations on the Orange Line, 26 local and 7 express bus routes, and two commuter rail lines. Three of the Orange Line stations–Sullivan Square (in Charlestown), Wellington (in Medford), and Malden–are major bus hubs. There is substantial parking at Oak Grove, the end of the line, as well as at Sullivan Square and Wellington. Patronage at Community College Station, in Charlestown, is almost entirely walk-in or drop-off.

The express buses serve Woburn, Burlington, and parts of Medford, and terminate at points in Boston Proper. Some of the local bus routes anchored at the Orange Line stations offer circumferential connections to destinations in the Northeast or the Northwest Corridors. The local routes that radiate away from Boston add Winchester, Melrose, Stoneham, Wakefield, and Reading to the list of cities served in the North Corridor.

The Lowell and Haverhill commuter rail lines round out the MBTA services in the North Corridor. The Lowell Line has stops in Woburn, Winchester, and Medford, and the Haverhill Line has stops in Malden, Melrose, Wakefield, and Reading. All seven of these communities also having bus service, and in the case Malden and Medford, Orange Line service as well. The Anderson Regional Transportation Center (RTC) in Woburn on the Lowell Line has the best freeway access of any commuter rail



MAP B-1
North Corridor
of the MBTA Service Area

Population Density, 2000

U. S. Census 2000
Population/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 176,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

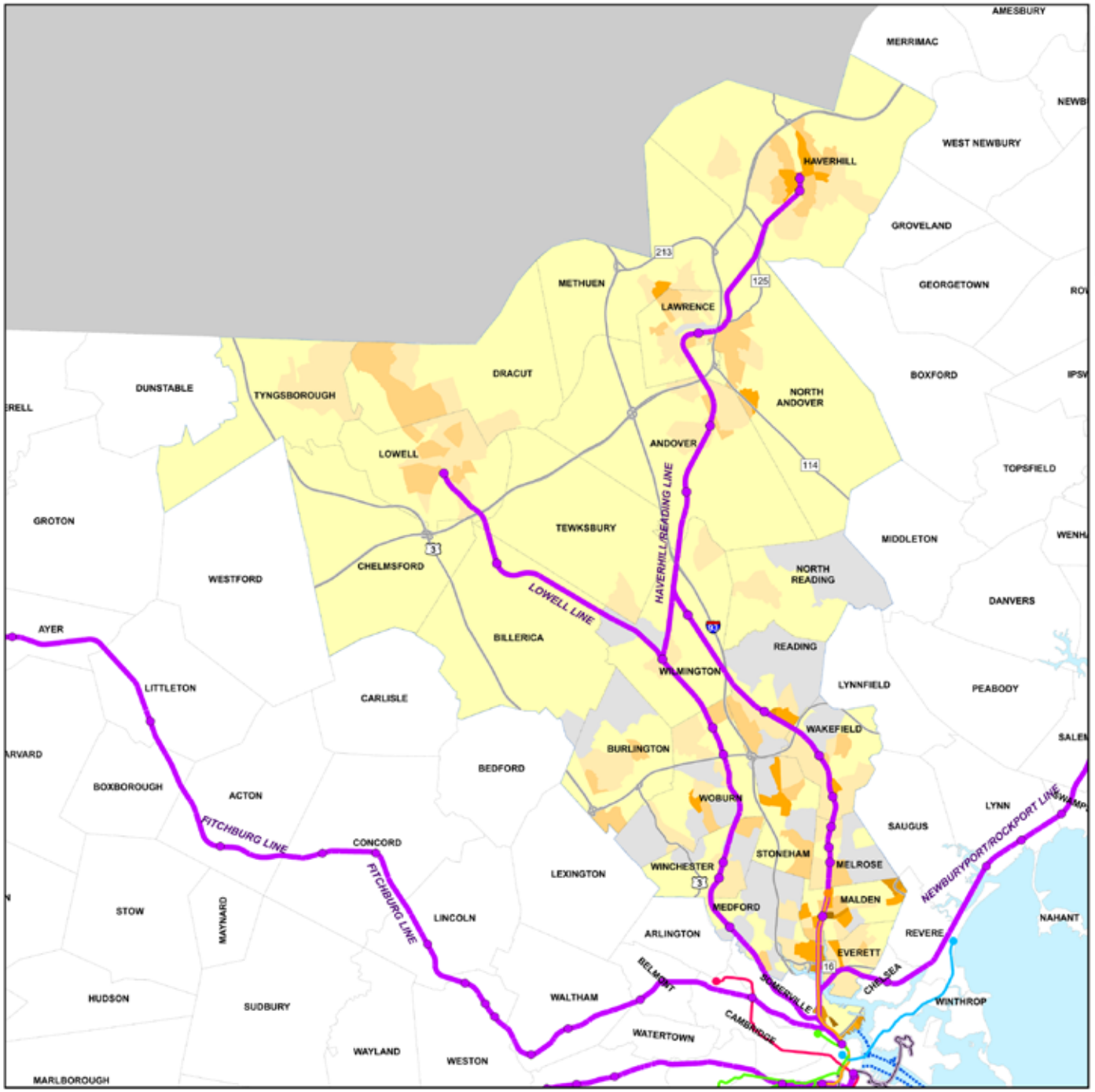
- Commuter rail line

0 1.5 3 6 Miles

MBTA Program for Mass Transportation

March 2008

N



MAP B-2
North Corridor of the MBTA Service Area

Projected Change in Population Density from 2000 to 2030

2030 MetroFuture Projection
Change in Population/Sq. Mi. by TAZ

- -4,086 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 164,061

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 1.25 2.5 5 Miles

MBTA Programs for Mass Transportation

March 2008

N

station and has ample parking, including some dedicated long-term parking for patrons of the Logan Express bus service.

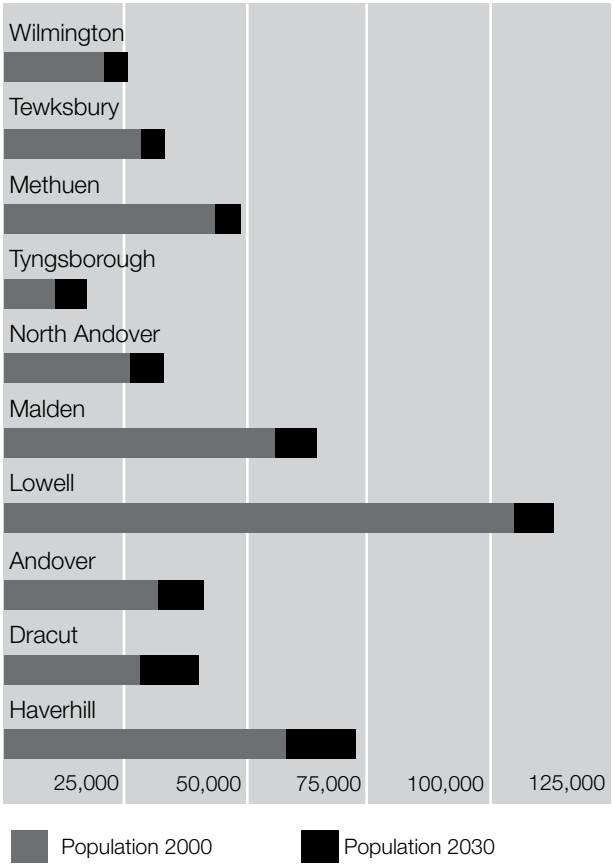
In addition to the MBTA, the Lowell Regional Transit Authority (LRTA) and the Merrimack Valley Regional Transit Authority (MVRTA) also provide public transportation services in the corridor. The LRTA operates 18 bus routes in the northern portion of the corridor which radiate from the commuter rail station in Lowell. One of these routes serves the Burlington Mall, where connections can be made to MBTA bus service. The MVRTA operates 23 routes in the northern portion of the corridor. Transfers between the LRTA and the MVRTA can be made at the Lowell Transit Center.

Population

The largest densely populated areas in the corridor are within Charlestown, Everett, Medford, and Malden, as well as in the cities of Lawrence, Haverhill, and Lowell, which are farther from the urban core (see Map B-1). Only small sections of several communities are projected to become significantly more densely populated between 2000 and 2030. These include parts of South Boston and Malden. In general, population density in the corridor is projected to remain relatively stable, with most communities experiencing moderate gains or losses (see Map B-2).

According to the U. S. Census, the corridor's year 2000 population was 843,901. This population is projected to increase by 14% to 960,599 by 2030.[1] More than one-third of the corridor's growth will occur in Tyngsborough, Dracut, Haverhill, and Andover, the latter two of which are directly served by MBTA commuter rail. Population in one third of corridor communities will remain fairly stable, increasing by less than 10% (see Figure B-1).

FIGURE B-1
North Corridor 2000-2030
Population Growth: Top Ten Communities in Order of Increase



Among the larger housing developments planned for the corridor are 500 units in the Haverhill 40R district, within walking distance of the Haverhill commuter rail station; the 650 units under construction at Station Landing in Medford; and the 550 units under construction at Oak Grove Village in Malden and Melrose, at the end of the Orange Line.

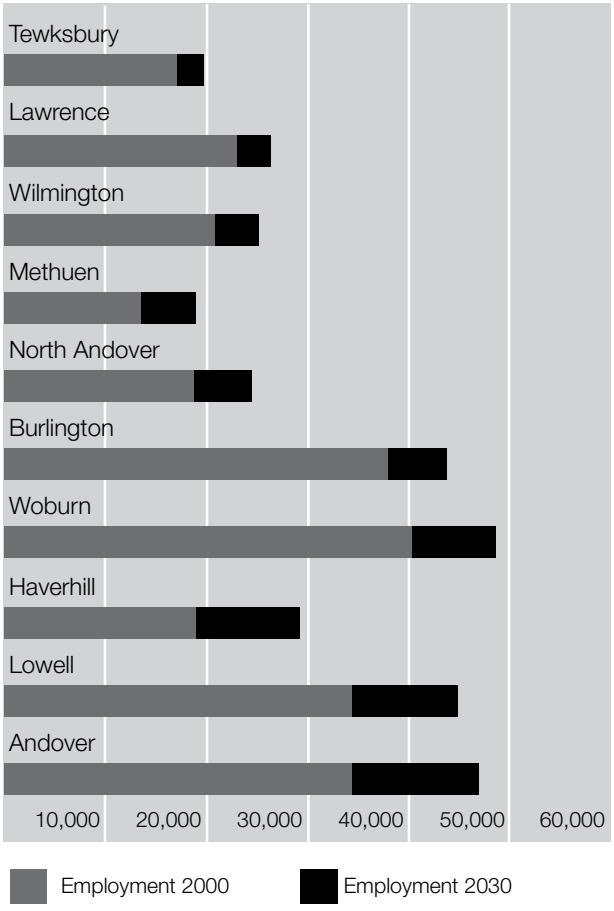
Employment

The areas of dense employment are scattered throughout the corridor, but primarily in the communities closest to Boston, along commuter rail lines, and in older downtowns (see Map B-3). Increases in employment density between 2000 and 2030 are projected to occur mostly along Route 128, Route 495, and I-93 (see Map B-4).

1 Metropolitan Area Planning Council (MAPC), Merrimack Valley Planning Commission (MVPC), and Northern Middlesex Council of Governments (NMCG) population and employment forecasts.

Employment in the corridor is projected to increase by 19% between 2000 and 2030, with most communities experiencing modest growth in absolute terms.[2] Everett and Malden are projected to experience minor employment losses, and more than half the corridor's growth will occur in Andover (16%), Haverhill (13%), Lowell (13%), and Woburn (11%). Woburn will continue to have the corridor's highest employment (see Figure B-2).

FIGURE B-2
North Corridor 2000-2030
Employment Growth: Top Ten Communities in Order of Increase

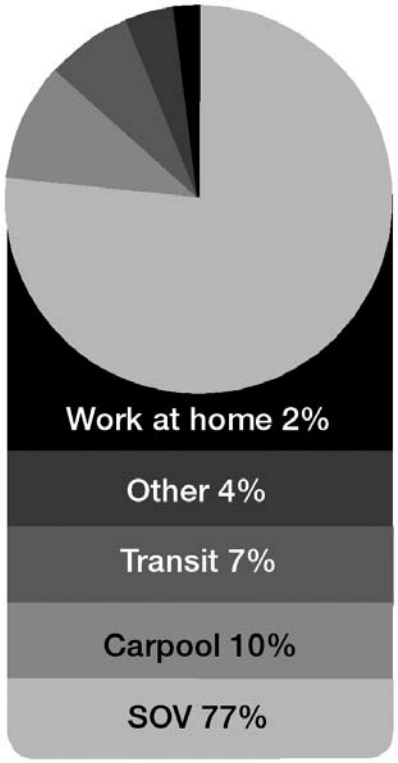


Two large employment developments currently proposed for the corridor include Lowell Junction, in Andover, Wilmington, and Tewksbury, and Osgood Landing, in North Andover. The Lowell Junction site proposal envisions 3 million square feet of commercial and industrial space. The master plan for Osgood Landing calls for over 1 million square feet of industrial, office, and retail space.

Journey to Work

Nationally, work trips account for a small proportion–15%–of all trips.[3] Because most commuting occurs during peak travel times, work-trip volumes determine the capacity needs, as well as the performance, of highway and transit systems. In 2000, of all work trips that originated in the North Corridor, 77% were made in single-occupancy vehicles (SOVs), and 7% were made by transit (see Figure B-3).

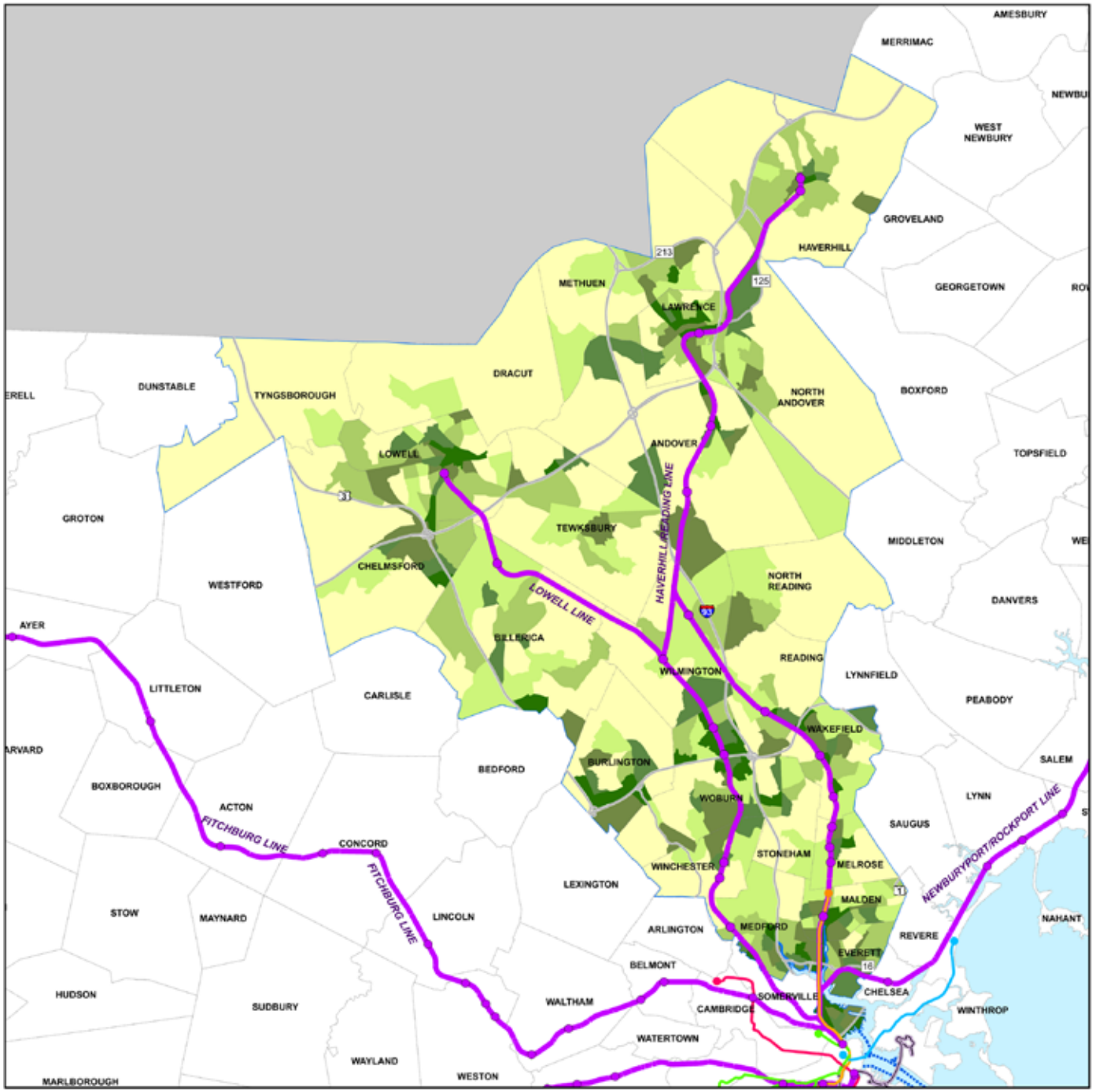
FIGURE B-3
2000 Travel Modes to Work by North Corridor Residents



Most MBTA service is radially oriented towards Cambridge and Boston, which together are the destination for 10% of the work trips made by corridor residents. Of the corridor's work trips to Cambridge and Boston, 32% are made by transit. Medford, Melrose, and Everett originate 40% of the corridor's work trips to Cambridge and Boston (see Figure B-4.)

2 Ibid.

3 Transportation Research Board, *Commuting in America III: The Third National Report on Commuting Patterns and Trends*, NCHRP Report 550, October 2006, p. 3.



MAP B-3
North Corridor of the MBTA Service Area

Employment Density, 2000

2000 CTPS Employment Database
Employees/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 1,000,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

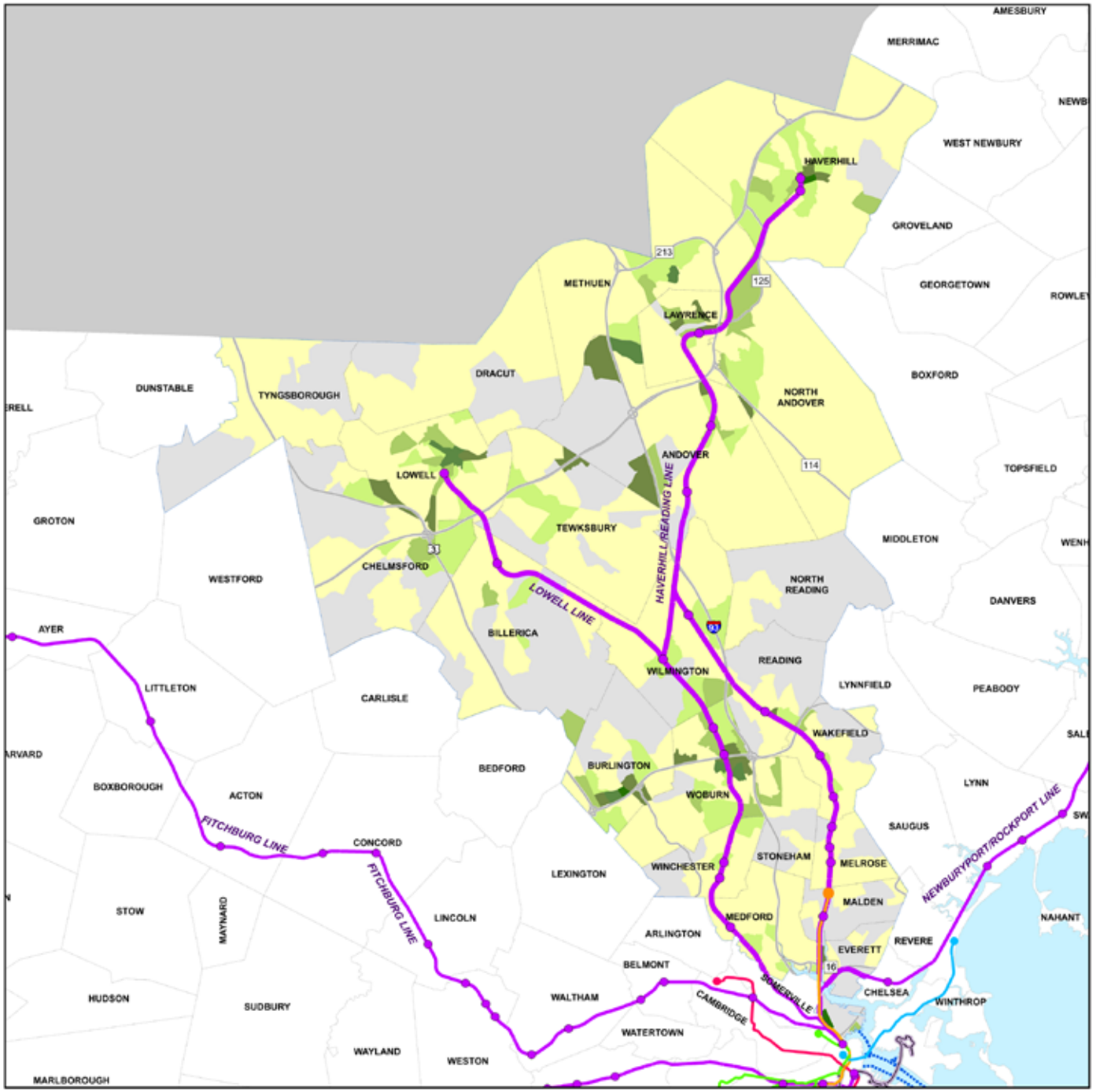
- Commuter rail line
- Special MBTA sporting events

0 1 2 4 Miles

MBTA Program for Mass Transportation

March 2008

N



MAP B-4
North Corridor
of the MBTA Service Area

Projected Change in Employment Density from 2000 to 2030

2030 MetroFuture Projection
Change in Employees/Sq. Mi. by TAZ

- -94,000 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 400,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Mattapan High Speed Line
- Red Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

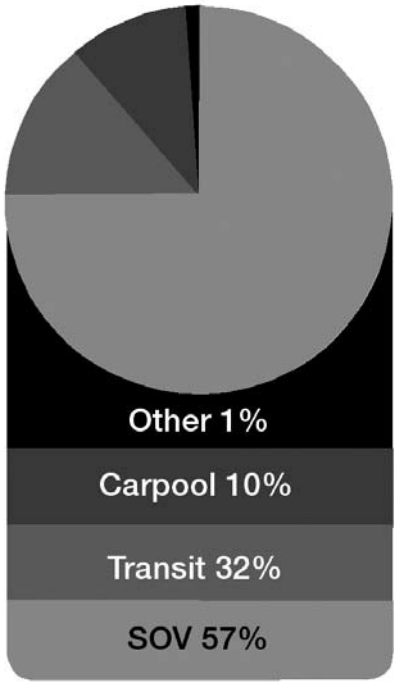
0 1.5 3 6 Miles

MBTA Programs for Mass Transportation

March 2008

N

FIGURE B-4
2000 Travel Modes to Work by North Corridor Residents to Boston and Cambridge



Traffic Congestion

The main radial highways in this corridor are Route I-93 North, which runs from the New Hampshire border with Methuen to and through downtown Boston, and U.S. Route 3, which runs as a limited-access highway between the New Hampshire border and Route 128. To continue to Boston, vehicles must travel a few miles in either direction on Route 128 to reach another limited-access connection. (Some unlimited-access roads are designated as Route 3 between Route 128 and Boston.)

AM peak-period southbound travel speeds are in the 30 to 44 mph range over much of the segment of I-93 between I-495 and Route 128. There is also heavy congestion on I-93 in the last few miles approaching Boston, with average speeds there dropping to below 30 mph.

Travel Projections

The CTPS regional travel-demand model provides estimates of current travel volumes and projections of future travel volumes for all major modes: auto, transit, and walk/bike. A useful way of tracking travel growth patterns is to look at the change in travel between pairs of municipalities, to include trips beginning and ending in the same municipality. By 2030, there are 50 travel pairs in the Northeast Corridor, with projected increases of at least 1,000 two-way trips per day. The projected travel volume increase for these 50 pairs is 224,556 trips per day (approximately 18%).

Of the 50 pairs with projected travel volume increases of over 1,000, 20 are for trips that begin and end within one municipality, and 26 are between adjoining municipalities. Interestingly, the largest increases in the corridor are for trips made entirely within Tewksbury (13,505), within Billerica (12,959), within Chelmsford (12,906), within Lowell (12,590), within Malden (11,845), within Haverhill (11,803), within Andover (11,577), within Burlington (10,789), within Methuen (10,343), and within Everett (9,366). (See Figure B-5.)

FIGURE B-5
North Corridor Trip Increases 2000 - 2030: Top Ten in Order of Increase

At present, transit coverage within the North Corridor varies among communities, with those nearest to Boston having the most extensive coverage. Of the top 10 projected trip increases, 7 are in municipalities that have local bus service provided by the Lowell Regional Transit Authority (LRTA) or the Merrimack Valley Regional Transit Authority (MVRTA), but not by the MBTA. Two others (Malden and Everett) have extensive MBTA local bus route networks. Burlington has some bus service provided or funded by the MBTA and some provided by the LRTA.

The model also projects increases of over 1,000 daily trips between points in the Northeast Corridor and points in other PMT corridors, including 7 with the Northeast Corridor and 10 with the Northwest Corridor. The largest increases are between Somerville and Charlestown (2,835), between Burlington and Lexington (2,833), between Bedford and Billerica (2,539), and between Lexington and Woburn (2,241). The projected increases for the other 13 pairs are below 2,200 each.

Environmental Justice

The federal government defines environmental justice (EJ) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, education level, or income with respect to the development, implementation, and enforcement of environmental laws. The MBTA monitors EJ through implementation of and reporting for Title VI of the Civil Rights Act of 1964.

The North Corridor encompasses Boston's densely populated neighborhood of Charlestown, part of which is classified as a minority area for Title VI. Five other municipalities in the North Corridor—Everett, Malden, Medford, Lowell, and Lawrence—contain census tracts that are classified as minority. Lowell and Lawrence have tracts that are classified as both minority and low-income.

Thirty-three bus routes run through this corridor; 10 are classified as minority, one is classified as low-income and one is both minority and low-income.

A portion of the Orange Line runs through this corridor. There are four Orange Line stations in this corridor, two of which meet the minority station criterion.

Both the Lowell and Haverhill commuter rail lines operate in this corridor. Four commuter rail stations in this corridor meet the minority station criterion; one meets the criteria for both minority and low-income.

MOBILITY PROBLEMS AND PROPOSED SOLUTIONS

Capacity Improvements Are Needed

Investments will be needed to ensure that sufficient capacity is available to serve current and projected travel demand.

Problem 1:

Malden had the fifth-highest total number of intracity trips in the corridor in 2000 (46,365), and is projected to have the fifth-largest increase in trips within any single municipality in the corridor by 2030. However, Malden's transit mode share is comparatively low, despite a robust bus and rail network.

Proposed Solutions:

- Strengthen the identity of common service corridors associated with major employment, residential, or other activity hubs by consolidating services, providing real-time customer information, and enhancing bus stop facilities.
- Create a busway and operate bus-rapid-transit (BRT) service in the existing rail right-of-way parallel to Salem Street from Linden Square to Malden Center.

Problem 2:

The Orange Line is currently overcrowded during peak hours between Downtown Crossing and North Station.

Proposed Solution:

Purchase additional Orange Line cars, increase storage capacity, and improve electrical capacity so that more frequent service can be operated.

Problem 3:

By 2030, modeling projections suggest that one bus route in the North Corridor (Route 132) will be projected to experience passenger crowding levels that would trigger the need for additional service.

Proposed Solution:

To increase peak-period capacity and to ensure that crowding does not exceed safe and comfortable levels, one additional 40-foot bus will be required to operate this route.

Problem 4:

Medford currently displays high trip volumes to Somerville and to Boston; however, these trips are not served by rapid transit (Wellington Station serves the east side of Medford directly).

Proposed Solutions:

- Extend the Green Line to Medford.
- Add an Orange Line station at Assembly Square.

Problem 5:

Very densely populated areas in Everett, which currently generate significant numbers of trips into the urban core, do not have access to rapid transit service.

Proposed Solution:

Create BRT service to Glendale Square in Everett from Sullivan Station via Broadway, or from Wellington Station via Revere Beach Parkway and Broadway (integrate with Urban Ring).

Problem 6:

During the morning peak period, Boston-bound commuters experience reduced travel speeds and increased travel times on I-93 and Route 128.

Proposed Solutions:

- Extend commuter rail from Haverhill to Plaistow, NH.
- Extend commuter rail from Lowell to Nashua.

Problem 7:

The Haverhill Line layover facility at Bradford creates noise pollution and localized air pollution in the midst of a densely developed residential neighborhood.

Proposed Solution:

Extend the Haverhill Line to a new station and layover facility north of downtown Haverhill (could be part of an extension to Plaistow and would decrease customer complaints about noise from the layover facility at Bradford, which opened in 1987).

Problem 8:

A major commercial and residential development at Assembly Square that has been proposed could create additional burdens for an already congested area road/highway system.

Proposed Solution:

Add an Orange Line station at Assembly Square.

Problem 9:

Proposed projects adjacent to the Haverhill Line that promote smart growth and economic development should be supported.

Proposed Solution:

Build a new station in North Andover or Andover.

Access to MBTA Services Needs to Be Improved

ADA Accessibility

Problem:

Although the MBTA has made strides toward providing ADA accessibility to all of its services, some gaps still remain. Winchester, Wedgemere, and West Medford stations, on the Lowell Line, and North Wilmington, Wakefield, Greenwood, Melrose Cedar Park, and Wyoming Hill on the Haverhill Line, have not yet been made accessible.

Proposed Solution:

Based on the feasibility of construction, the following stations are a priority for near-term accessibility improvements (see Table B-1):

TABLE B-1
North Corridor
Station Accessibility Priorities

Line	Station	Priority
Haverhill	North Wilmington	Low
	Wakefield	Medium
	Greenwood	Low
	Melrose Cedar Park	Low
	Wyoming Hill	Low
Lowell	Winchester	Medium
	Wedgemere	Low
	West Medford	Medium

Station Parking

Problem 1:

Access to rail transit services for customers of all abilities is constrained by the availability of parking, both for automobiles and for bicycles. An inventory of station parking that was completed during the fall of 2005 and winter of 2006 shows that parking at the following stations (see Table B-2) is utilized at 85% of capacity or greater.[4]

TABLE B-2
North Corridor
Station Parking at 85% Usage or Greater

Line	Station
Haverhill	Haverhill
	Andover
	Ballardvalle
	North Wilmington
	Reading
	Wakefield
	Greenwood
Lowell	Wilmington
	Winchester
	North Billerica
	Wedgemere
Orange	Malden
	Oak Grove
	Sullivan Square
Express Bus	Woburn

Proposed Solution:

The MBTA can address inadequate parking capacity either by increasing the number of spaces or controlling demand through measures like raising the price of parking overall or installing automated parking fee collection at MBTA lots to allow for congestion pricing and to improve enforcement of parking regulations.

When evaluating expansion of parking, the availability of MBTA-owned land, the potential cost of acquiring nearby land, and the potential cost of a multilevel structure are all important considerations. Based on these and other feasibility criteria, the following stations have potential for expansion of MBTA parking: Andover and Ballardvalle on the Haverhill Line, and North Billerica on the Lowell Line.

Problem 2:

For some customers, access to rail services is constrained by the lack of bicycle parking. A recent study provided a detailed inventory of bicycle amenities, by MBTA station, that included the location, number, and condition of bike racks, bike rack shelters, and signage directing cyclists to them. The study also noted that at some stations where bike racks were provided, cyclists did not utilize the racks, but parked their bikes elsewhere.[5]

Proposed Solution:

The study recommended that the MBTA continue to expand bicycle parking at stations; however, the MBTA does not currently have a standard for determining what the appropriate number of spaces would be for each station. The study therefore also recommended that the MBTA adopt a standard for providing bicycle parking spaces at transit stations.

In instances where bikes were parked at locations other than at bike racks that were provided,

4 Fijalkowski, Jared, and Ostertog, Heather, *Inventory of Park-and-Ride Lots at MBTA Facilities*, Central Transportation Planning Staff, February 27, 2007.

5 Fijalkowski, Jared, and Yaitanes, Justin, *2005–2006 Inventory of Bicycle Parking Spaces and Number of Parked Bicycles at MBTA Stations*, Central Transportation Planning Staff, October 2, 2007, Table 6.

the study made recommendations, based on the type of problem observed, including:

- The rack was in an inconvenient location (e.g., far from the platform)
- The rack was not sheltered from the weather
- The rack was in a secluded location that was difficult to find or might encourage theft
- The rack was damaged or difficult to use

The following specific improvements (Table B-3) are recommended for stations at which existing bike racks were not used.[6]

TABLE B-3
North Corridor
Bicycle Parking Improvements

Line	Station	Bicycle Parking Enhancement Recommendation
Orange	Oak Grove	Provide shelter for existing racks.
Haverhill	Bradford	Install signs directing bicyclists to racks.
	Andover	Relocate existing racks to sheltered area.
Lowell	Lowell	Install additional racks in sheltered area.
	Winchester Center	Relocate one rack to location visible from the street.

Connections with Other RTAs

Problem:

The North Corridor is served by two Regional Transit Authorities that provide connections to MBTA services. The Lowell Regional Transit Authority (LRTA) operates from a commuter rail terminal and provides many good connections to MBTA rail services. The Merrimack Valley Regional Transit Authority (MVRTA), however, provides very few opportunities to make transfers between the bus routes and the commuter train.

In this corridor, the MVRTA operates nine routes that serve Haverhill, originating at the Washington Square Transit Station in downtown Haverhill, about 0.2 miles from the Haverhill commuter rail station. Of these, only two routes run directly past the station. Some trips on each of these routes provide very close connections with commuter trains. MVRTA also operates one route that makes a route deviation on request to the Bradford commuter rail station on outbound trips from Haverhill.

MVRTA operates 13 routes that originate in downtown Lawrence at the Buckley Transportation Center, which is about one-half mile from the Lawrence commuter rail station in South Lawrence on the other side of the Merrimack River. Only 1 of these bus routes serves Lawrence Station directly, and the departure times on this route do not coordinate well with train schedules.

The MVRTA also operates the Andover Shuttle, which runs past the Andover commuter rail station and provides a close connection with one inbound AM peak-period train, and one outbound PM peak-period train.

The LRTA operates 17 routes that radiate from the Lowell commuter rail terminal and an Express Shuttle that provides connections to downtown Lowell. If the buses and trains run on schedule, some local bus trips would provide very close connections. The Express Shuttle runs about every 10 minutes, making it possible to plan close connections between downtown Lowell and the trains. One LRTA route also stops at the North Billerica commuter rail station, but connections at this point are generally not convenient. Two LRTA routes extend to Burlington, where some connections to MBTA bus Routes 350, 351, and 352 are possible.

Although both the Merrimack Valley Regional Transit Authority (MVRTA) and the Lowell Regional Transit Authority (LRTA) serve the North Corridor, current schedules provide few close connections between RTA and MBTA services. In general,

6 Ibid.

RTA bus routes do not function well as commuter rail feeders, as they serve different purposes and populations. Most RTA routes provide local service on even headways, while commuter rail provides long-distance commuter service and operates on uneven headways due to a number of equipment and operational constraints. In addition, because RTA routes have frequent stops and many do not provide direct service to stations, using them to access stations is much slower than driving.

Proposed Solution:

Adjusting the RTA services to meet the commuter rail schedules would inconvenience customers making local trips. Changing the commuter rail schedules to coordinate with RTA services would require significant capital and operating costs without significantly improving service for most commuter rail riders. The best solution, therefore, would be to create specific RTA feeder services to commuter rail. It is recommended that as demand for commuter rail feeder service increases, the MBTA work with the MVRTA and LRTA to select one or more stations on commuter rail routes in the corridor and to determine the number and alignment of routes that would be required to provide adequate feeder services.

Reverse-Commute Service

Problem:

In the North Corridor, thre is some potential for reverse-commute service between residential areas of Boston and employment sites in Woburn near the Anderson/Woburn Station on the Lowell Line.[7] To attract sufficient riders to justify such service, bus or van connections from the station to employment destinations along Route 128 would need to be provided.

Proposed Solutions:

- The MBTA should work with the Route 128 Business Council TMA (transportation management association) to provide shuttle service to commuter rail.
- Expand reverse-commute options by adding outbound AM-peak and inbound PM-peak commuter rail trips

Infrastructure Enhancements Are Needed

Problem:

In order to continue to maintain and improve service quality as demand grows and as technologies and materials improve, the MBTA will need to continually invest in infrastructure enhancements.

Proposed Solution:

Some of the enhancement projects that have been identified as future needs are identified in Table B-4.

7 Humphrey, Thomas J., *MBTA Reverse Commuting Study*, Central Transportation Planning Staff, May 2001, pp. ES-2 and ES-5.

TABLE B-4
North Corridor
Infrastructure Enhancement Projects

COMMUTER RAIL	
Asset Category	**Project Description**
Facilities	Midday layover and additional track storage at the Boston Engine Terminal.
Track/right-of-way	Double track the Wildcat Branch connecting the Lowell and Haverhill Lines.
LOWELL LINE	
Asset Category	**Project Description**
Facilities	Construct a layover facility near the Lowell Line terminus to eliminate the need for inefficient deadhead moves from Boston Engine Terminal at the start of daily operations.
Power	Install a transformer containment yard at Mystic Junction on the Lowell Line, 0.13 miles north of Washington Street in Somerville.
Signals	Complete the Traffic Control System (TCS) signal system upgrade on the Lowell Main Line between Wilmington Interlocking and Shop Interlocking.
Signals	Complete a Traffic Control System (TCS) signal system upgrade on the Lowell Line between Somerville Junction and Winchester.
Track/right-of-way	Eliminate the Bleachery Interlocking, including relocating Guilford's train operations from Lowell to Lawrence, removing crossovers between the MBTA's New Hampshire Main Line operations and Guilford's Lowell Branch, relocating one crossover, and removing four other crossovers. By moving a large amount of track and signaling equipment beyond the Lowell commuter rail station, redundancies would be eliminated and the rail line would be improved.
Track/right-of-way	Rehabilitate the Montvale facility.
HAVERHILL LINE	
Asset Category	**Project Description**
Signals	Implement signal improvements on the Haverhill Line to enhance train throughput, including the design and installation of a power switch at Ash Street in Reading and the redesign of Wilmington Junction Interlocking as a universal crossover between the Wildcat Branch and the Haverhill Line tracks.
Signals	Upgrade the signal system to a modern bi-directional Centralized Traffic Control System (TCS) on the Haverhill Line from Andover Street to Rosemont.
Signals	Install cross over/signal system at Lawrence.
Track/right-of-way	Add double track to the Haverhill Line between Lowell Junction and the Frey interlocking in Andover to reduce delays and improve the flexibility of scheduling both passenger and freight trains.
Track/right-of-way	Extend the Haverhill Line double track north through Reading Station. The extension would allow trains turning at Reading to be held clear of passing trains, thus reducing delays and freight conflicts.
Track/right-of-way	Construct second platform and connection to McGovern Intermodal Center in Lawrence Station.

A State of Good Repair Needs to Be Achieved

Problem:

A number of system preservation projects must be addressed in the short- to mid-term to bring the system into a state of good repair and to ensure the safety of passengers and reliability of service.

On the commuter rail system, a number of bridges are currently rated as structurally deficient, including one on the Lowell Line and six on the Haverhill Line. The MBTA's state fiscal year 2009–2012 Capital Investment Program (CIP) includes funding for design and rehabilitation of three of the Haverhill Line bridges.

On the Orange Line, power substation buildings and equipment are in need of replacement at Oak Grove, Malden, and Wellington, and upgrades are needed at all north-side Orange Line stations to improve passenger areas. Also on the Orange Line, the power system needs to be upgraded and the concrete support pedestals that support the third rail, as well as part of the third rail itself, need to be replaced. In addition, new Orange Line cars must be purchased, so that the 1979–1981 fleet can be retired.

The Wellington Orange Line maintenance facility is in need of renovations.

Proposed Solution:

Some of the specific projects needed to bring the system into a state of good repair and maintain it in that condition include:

TABLE B-5
North Corridor
State-of-Good-Repair Projects

BUS	
Asset Category	**Project Description**
Maintenance	Replace existing compressors with new compressors and air dryers at the Charlestown Bus Repair Garage.
Maintenance	Install new gas-fired boiler system at Charlestown buildings No. 2 and No. 3.
Maintenance	Replace the rooftop and air conditioning system at Charlestown.
ORANGE LINE	
Asset Category	**Project Description**
Maintenance facilities	Renovate the Orange Line Wellington facility. Add a second rinse unit and construct a separate storage facility for non-revenue vehicles.
Power	Refurbish the Orange Line substation buildings and replace all the internal operating equipment for substations at Wellington, Malden, and Oak Grove. Upgrade power substations at Oak Grove, Malden, Wellington, Wellington Shop, Sullivan Square, Community College, and North Station.
Power	Install negative return cables from substations to track along the Orange Line.
Power	Install AC cable and DC breakers along the Orange Line.
Power	Upgrade the DC negative return system on the Orange Line.
Revenue vehicles	Procure new cars to allow the retirement of the No. 12 fleet.
Track/right-of-way	Replace concrete support pedestals that support the third rail on the Orange Line with 4,000 new blocks of treated wood. Replace approximately 2,000 feet of third rail in Orange Line station areas.
Track/right-of-way	Rebuild Orange Line track structures and replace yard turnouts in Wellington Yard.
COMMUTER RAIL	
Asset Category	**Project Description**
Bridges	Reconstruct Merrimack River Bridge (which currently has a 5 mph speed restriction) on the Haverhill Line.
Track/right-of-way	Replace 5.6 miles of 112-pound and 115-pound type rail on track between Winchester and Mishawum, a track segment used by both the Lowell and Haverhill lines.

Appendix C Northwest Corridor: Mobility Problems and Proposed Solutions

BACKGROUND

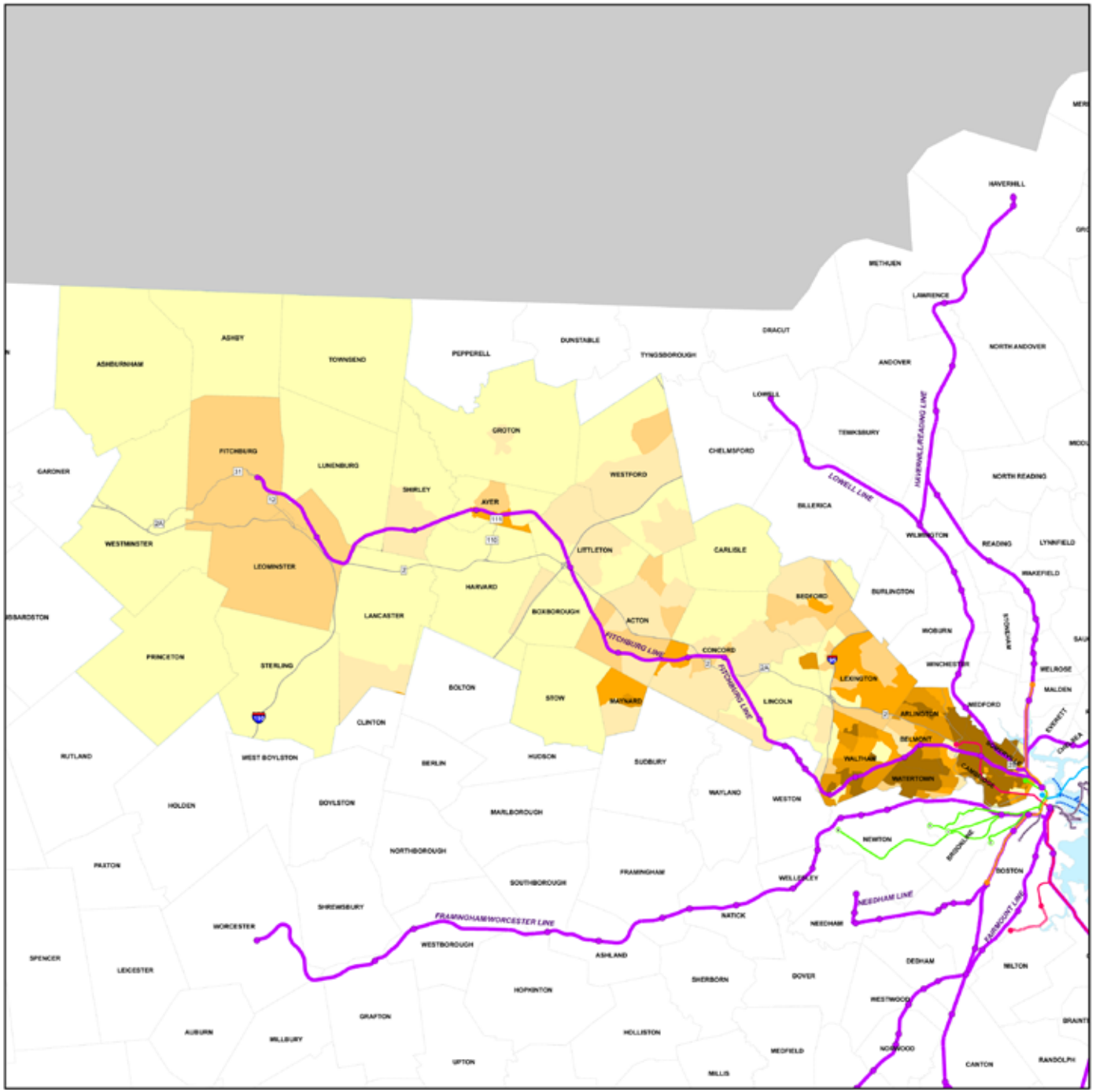
Existing Conditions

The Northwest Corridor includes 31 municipalities: the cities of Cambridge, Somerville, Watertown, Waltham, Leominster and Fitchburg, as well as 25 towns. The corridor stretches from the transforming industrial districts of NorthPoint in Cambridge and Assembly Square in Somerville to the towns west of Fitchburg, including the Mount Wachusett ski resort in Westminster.

The MBTA provides rapid transit, bus, and commuter rail service in this corridor. The Green Line terminates today at Lechmere Station, adjacent to the rapidly developing NorthPoint, and itself in a fully redeveloped former industrial district. The Red Line serves six stations in Cambridge and Somerville, and terminates at Alewife Station near the Belmont town line and at the eastern end of the limited-access portion of Route 2. Alewife Station, completed in 1985, is a major terminal for bus routes and park-and-ride commuters, as well as serving a gradually transforming former industrial area.

The MBTA operates 6 express and 35 local bus routes. Most of these bus routes are anchored at the Sullivan Square, Lechmere, Central Square, Harvard Square, or Alewife rapid transit stations. The route system fans out from these stations and extends through Cambridge, Somerville, Watertown, Waltham, Belmont, Arlington, and Lexington. Several routes extend into Bedford or Lincoln as well.

The Fitchburg commuter rail line serves 11 municipalities in the Northwest Corridor, as well as stopping in Weston, a municipality in the West Corridor. A connection with the Red Line is provided at Porter Square Station, making this one of the busiest commuter rail stations for trips not anchored at a downtown station. In Fitchburg, a dedicated, privately operated bus from the Mount Wachusett ski



MAP C-1
Northwest Corridor of the MBTA Service Area

Population Density, 2000

U. S. Census 2000
Population/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 176,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

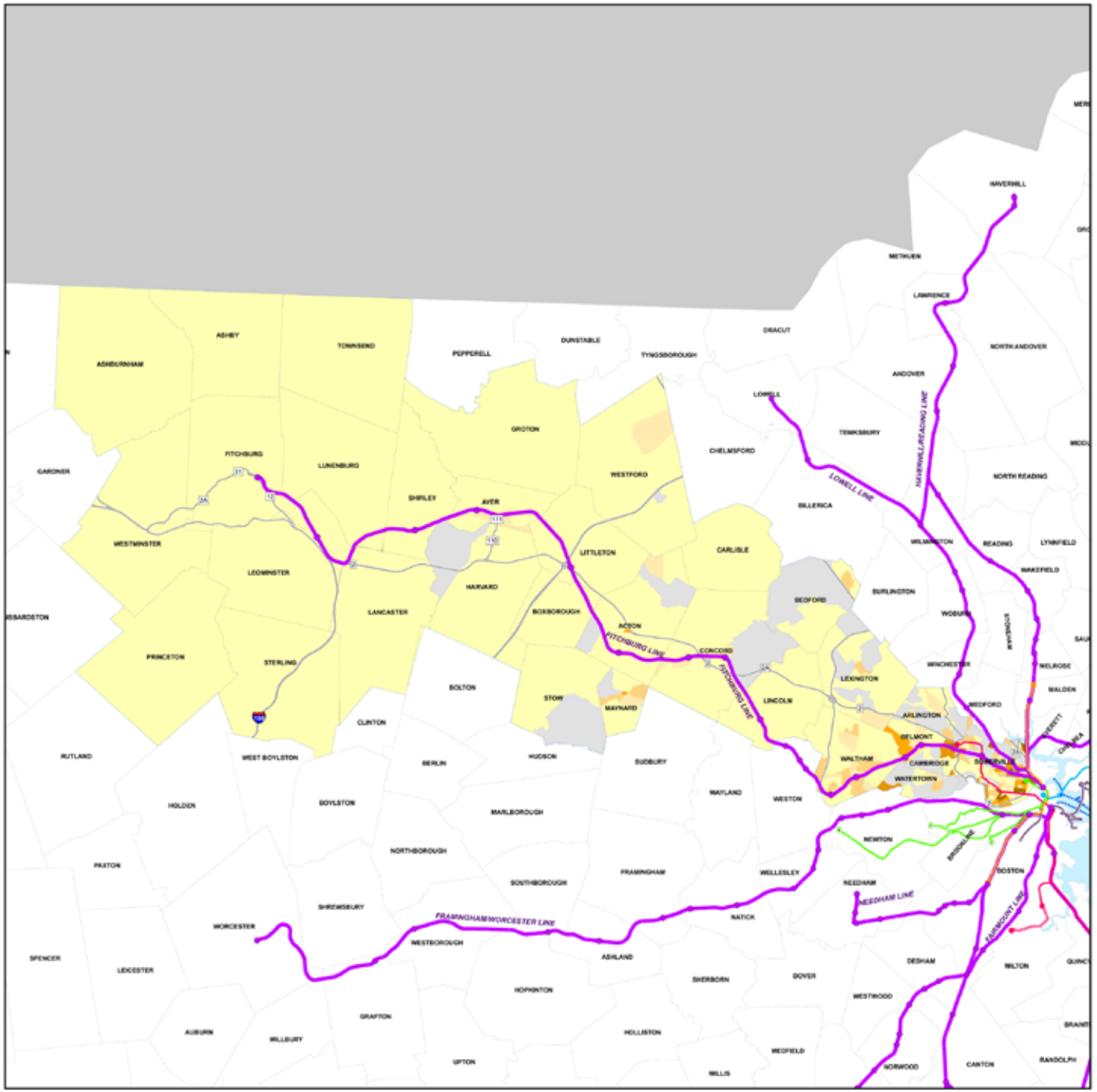
- Commuter rail line

0 2.5 5 10 Miles

N

MBTA Program for Mass Transportation

March 2008



MAP C-2
Northwest Corridor of the MBTA Service Area

Projected Change in Population Density from 2000 to 2030

2030 MetroFuture Projection
Change in Population/Sq. Mi. by TAZ

- -4,086 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 164,061

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 2 4 8 Miles

MBTA Programs for Mass Transportation

March 2008

N

resort offers guaranteed connections at Fitchburg to seasonal weekend trains, making the "Ski Train" a recent example of service innovation.

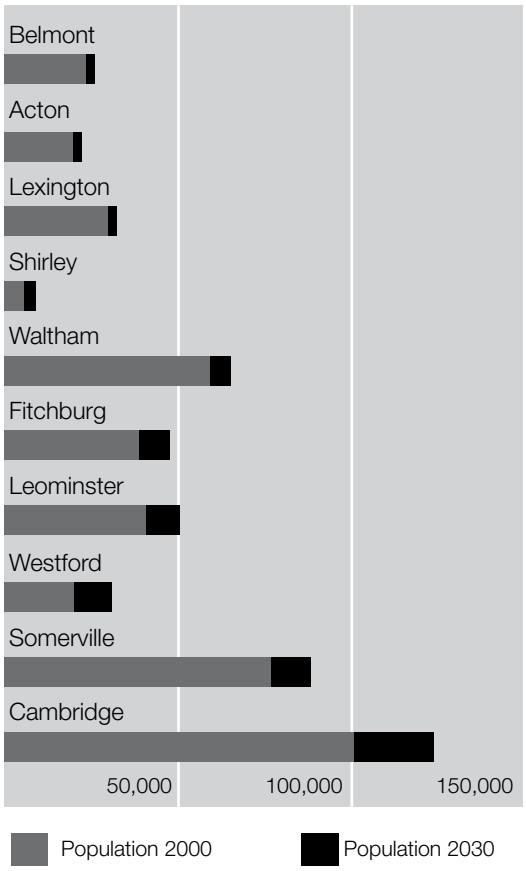
Bus service in the Northwest Corridor is also provided by the Montachusett Regional Transit Authority (MART). MART operates 8 bus routes from the intermodal center at the Fitchburg commuter rail station to points in Fitchburg, Leominster, and Lunenburg, as well as three other routes that are entirely within Leominster. MART also provides one route between Fitchburg and Gardner, two routes entirely in Gardner, and two connecting routes from Gardner to Winchendon and Orange.

Population

The most densely populated areas in the Northwest Corridor are located primarily inside of Route 128, particularly in the communities of Belmont, Cambridge, Somerville, Watertown, and Waltham. The majority of communities in the remainder of the corridor have low population densities. (See Map C-1.) With the exception of a few scattered areas within the most densely populated communities, population densities will not change much in the majority of corridor communities. (See Map C-2.)

According to the U. S. Census, the corridor's 2000 population was 642,409. In absolute terms, this population is projected to increase by 16% to 748,122 by 2030.[1] More than a third of the corridor's population is located in Cambridge, Somerville, and Waltham with Cambridge being the most populous community. Five communities, Cambridge, Fitchburg, Leominster, Somerville, and Westford, will account for 60% of corridor growth between 2000 and 2030. (See Figure C-1.)

FIGURE C-1
Northwest Corridor 2000-2030
Population Growth: Top Ten Communities* in Order of Increase



** Does not include Boston*

A number of large housing developments are proposed in this corridor. Two that are currently in the permitting process in the corridor are NorthPoint and Assembly Square. NorthPoint is adjacent to the Green and Orange Lines at Lechmere and Community College, respectively, and will have 2,500 residential units in Cambridge, Somerville, and Boston. Assembly Square will have 1,332 units in Somerville.

Employment

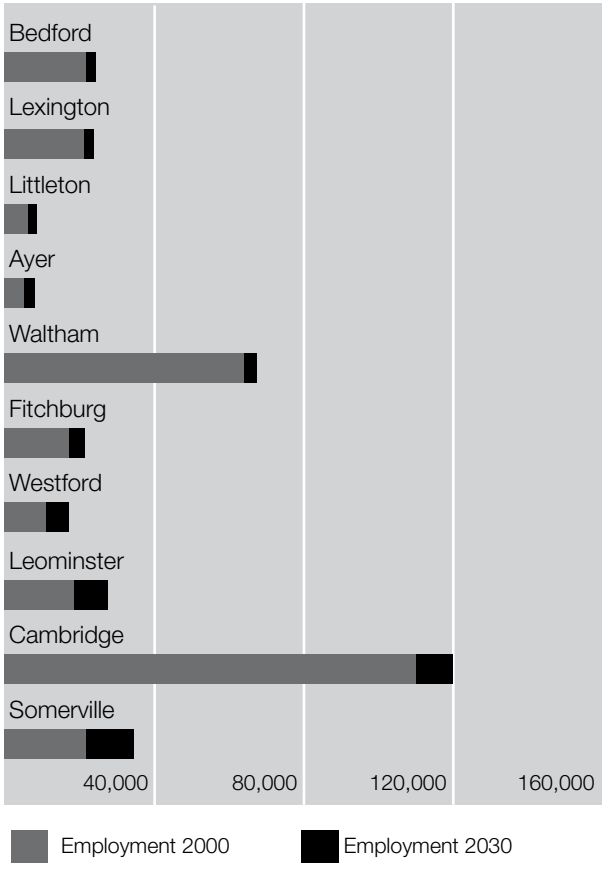
With the exception of Fitchburg, Leominster, and a few other scattered areas, mostly along I-495 and in Bedford, the highest employment densi-

1 Metropolitan Area Planning Council (MAPC), Central Massachusetts Regional Planning Commission (CMRPC), Montachusett Regional Planning Commission (MRPC), and Northern Middlesex Council of Governments (NMCG) population and employment forecasts.

ties in the Northwest Corridor are located inside Route 128, particularly in Cambridge, Somerville, and Waltham (see Map C-3). Although portions of a few communities are projected to become denser, most communities are not expected to experience major changes in employment density between 2000 and 2030. (See Map C-4.)

Between 2000 and 2030, employment in the corridor is projected to increase by 60% in Somerville, 55% in Westford, 47% in Leominster, and 9% in Cambridge. These four municipalities have the highest projected increase in the numbers of employees by 2030, and together they account for half of the increase projected for the entire corridor. (See Figure C-2.)

FIGURE C-2
Northwest Corridor 2000-2030
Employment Growth: Top Ten Communities in Order of Increase

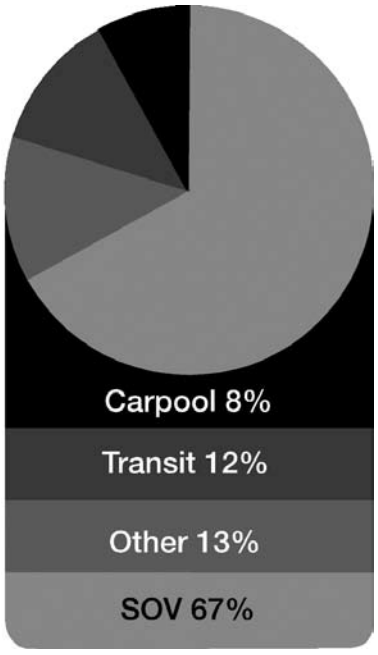


The NorthPoint and Assembly Square developments, in addition to adding substantial housing, will also include major employment components. NorthPoint envisions 2.2 million square feet of office space, while 1.0 million square feet of retail space is planned for Assembly Square.

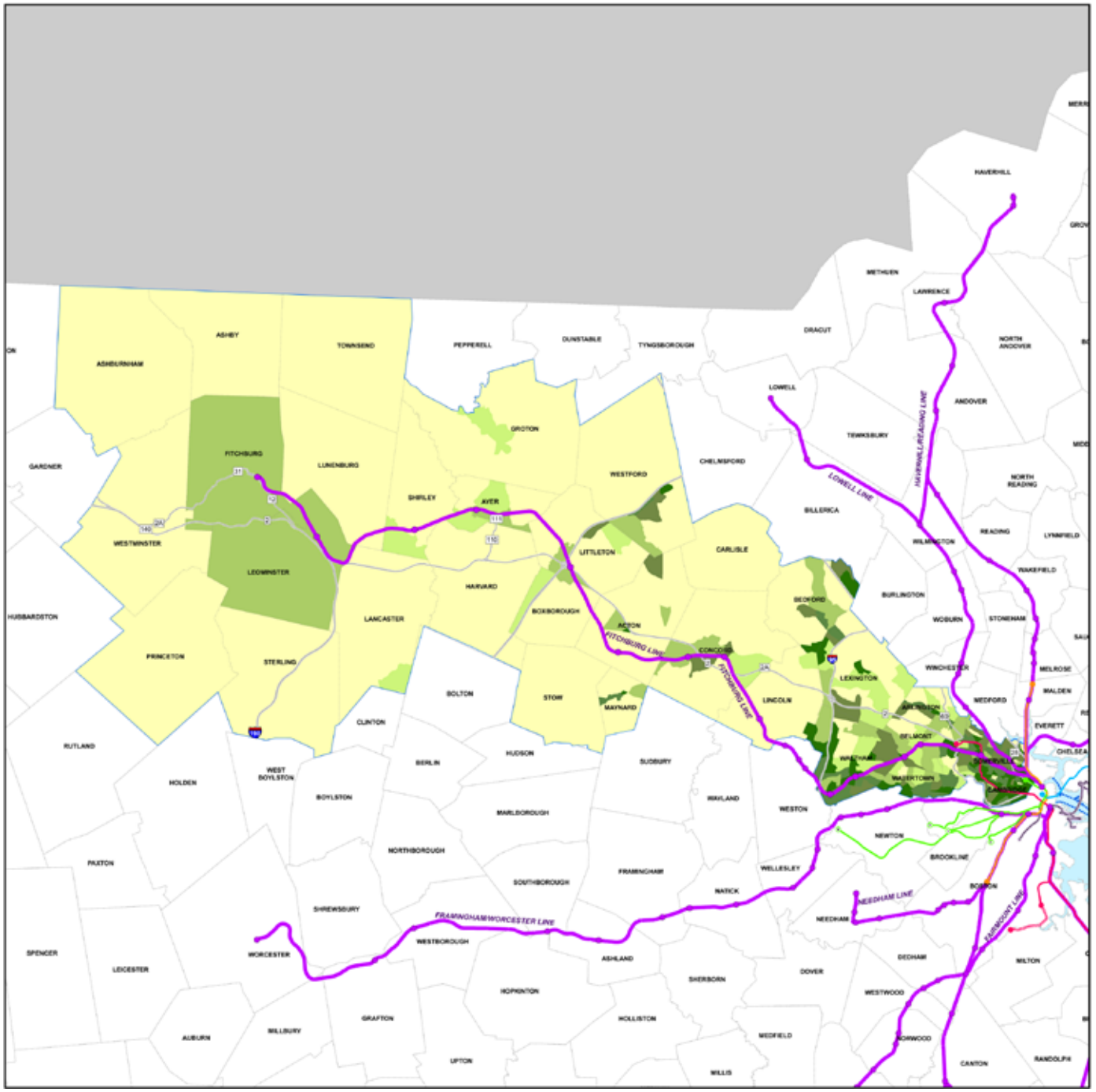
Journey to Work

Nationally, work trips account for a small proportion—15%—of all trips.[2] Because most commuting occurs during peak travel times, work-trip volumes determine the capacity needs, as well as the performance, of highway and transit systems. In 2000, 67% of all work trips that originated in the Northwest Corridor were made in single-occupancy vehicles (SOVs), and 9% were made on transit. Without the inclusion of heavily transit-dependent Cambridge and Somerville, the mode split (percentage of travel per mode of travel) would be 78% in single-occupancy vehicles and 6% on transit. (See Figure C-3.)

FIGURE C-3
2000 Travel Modes to Work by Northwest Corridor Residents



2 Transportation Research Board, *Commuting in America III: The Third National Report on Commuting Patterns and Trends*, NCHRP Report 550, October 2006, p. 3.



MAP C-3
Northwest Corridor of the MBTA Service Area

Employment Density, 2000

2000 CTPS Employment Database
Employees/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 1,000,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

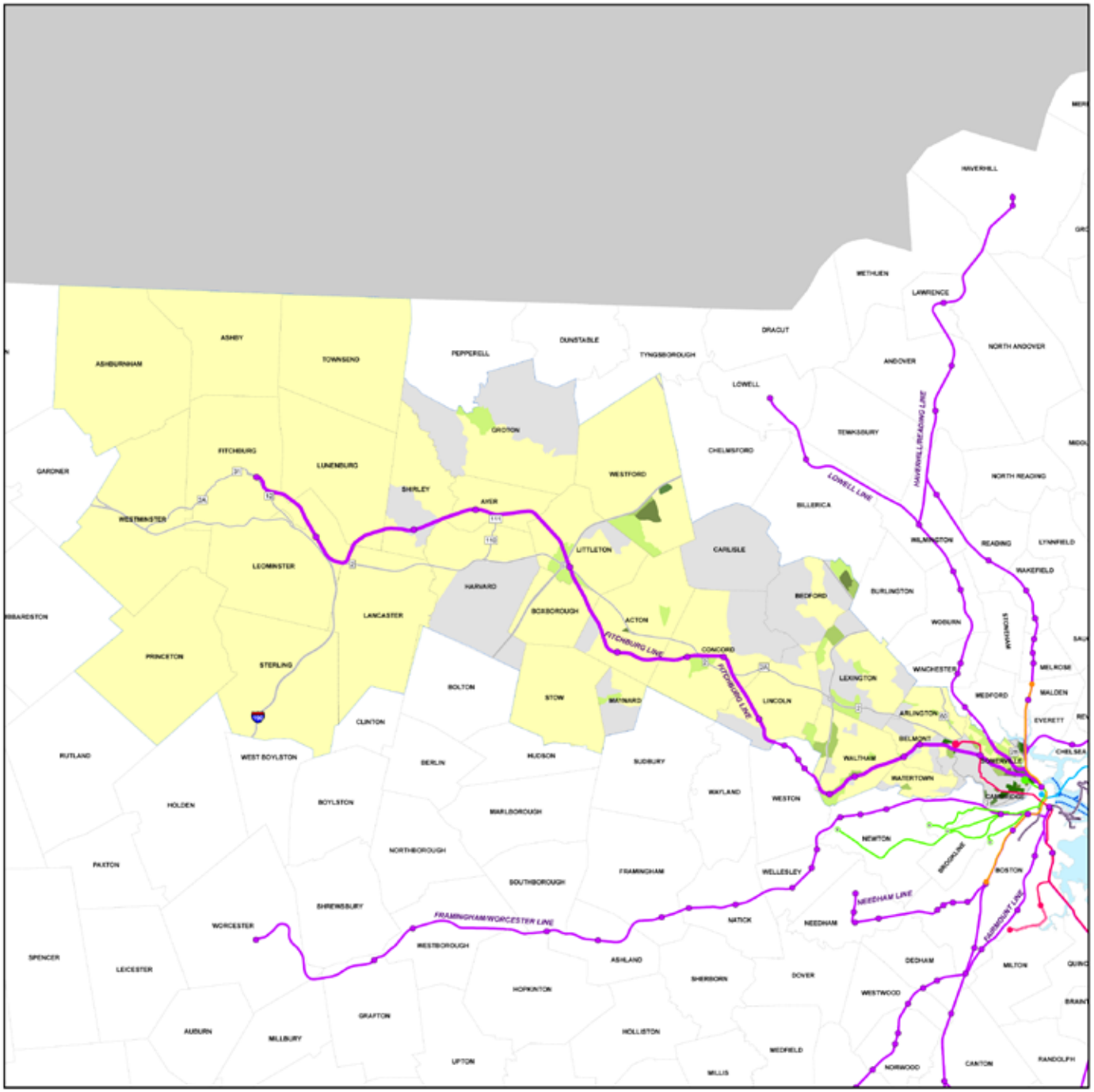
- Commuter rail line
- Special MBTA sporting events

0 1.5 3 6 Miles

N

MBTA Program for Mass Transportation

March 2006



MAP C-4
Northwest Corridor of the MBTA Service Area

Projected Change in Employment Density from 2000 to 2030

2030 MetroFuture Projection
Change in Employees/Sq. Mi. by TAZ

- -94,000 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 400,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Mattapan High Speed Line
- Red Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 2.5 5 10 Miles

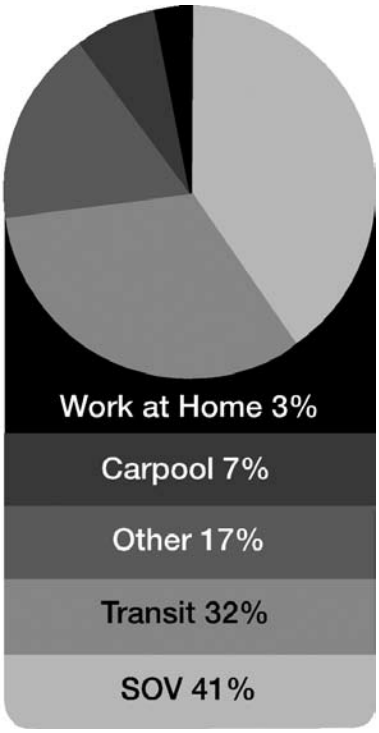
N

MBTA Program for Mass Transportation

March 2008

Most MBTA service is radially oriented towards Boston and Cambridge, which together are the destination for 31% of work trips made by corridor residents. Of work trips from the corridor to Boston and Cambridge, 41% are made in single-occupancy vehicles; 32% are made on transit. (See Figure C-4.)

FIGURE C-4
2000 Travel Modes to Work by Northwest Corridor Residents to Boston and Cambridge



Traffic Congestion

Route 2 is the major radial expressway in the corridor. It runs to Boston from points in northwestern Massachusetts. Between the New York state line and Phillipston, Route 2 is mostly a two-lane road with driveway access and surface intersections. When it enters the Northwest Corridor, it is a four lane, limited-access highway through Westminster, Fitchburg, Leominster, Lancaster, Harvard, Littleton, and Acton. Route 2 reaches the first of nine traffic signals just east of Route 111 in Acton.

East of the Concord Rotary, signalization, posted speed limits, and heavy traffic, cause average speeds to be about 30 miles per hour. Between I-190 in Leominster and Route 128, two-way daily traffic volumes tend to be between 40,000 and 50,000. For most of the distance between Route 128 and Alewife Brook Parkway Route 2 has six or eight lanes. This section of Route 2 serves about 100,000 vehicles per day.

The Fitchburg commuter rail line serves the same corridor. Recent counts show about 3,400 inbound riders a day on this line as they depart Concord Station. This is about 15% of the inbound daily vehicle volume on nearby sections of the Route 2.

Travel Projections

The CTPS Regional Travel Demand Model provides estimates of current travel volumes and projections of future travel volumes for all major modes: auto, transit, and walk/bike.

A useful way of tracking travel growth patterns is to look at the change in travel between pairs of municipalities, and to include trips beginning and ending in the same municipality. By 2030, there are 31 travel pairs in the Northwest Corridor with projected increases of at least 1,000 two-way trips per day. The projected travel-volume increase for these 31 pairs is 167,234 trips per day (approximately 21%).

Of the 31 pairs with projected travel volume increases of over 1,000, 15 are for trips that begin and end entirely within one municipality. The largest projected increases in the Northwest Corridor are trips made entirely within Cambridge (58,013) and entirely within Somerville (21,803). In addition, a fairly large increase is projected for trips between Cambridge and Somerville (5,528), which already show significant intracity trip-making activity (90,088 trips in 2000). (See Figure C-5.) Taken together, trips within and between these two cities account for 52% of the projected trip increases of over 1,000 in this corridor. It should be noted, however, that a large percentage of current trips within each city are made on foot, by bicycle, or via carpool.

For trips other than those between Cambridge and Somerville, the highest projected trip increases are

within Acton (8,249), within Concord (6,383), within Westford (6,350), and within Littleton (5,964). At present, there is no local transit service for the general public within any of these towns.

FIGURE C-5
Northwest Corridor Trip Increases 2000-2030: Top Ten in Order of Increase

The model also predicts 21 increases of over 1,000 daily trips between points in the Northwest Corridor and points in other PMT corridors, including 10 with the North Corridor, 9 with the West Corridor, and 1 each with Boston Proper and the Southwest Corridor. The largest of these increases are for trips between Newton and Waltham (5,375), between Cambridge and Allston (4,527), between Newton and Watertown, (3,561), between Somerville and Charlestown (2,835), between Burlington and Lexington (2,833), between Bedford and Billerica (2,539), and between Lexington and Woburn (2,241). The projected increases for the other 14 pairs are all less than 2,200.

Environmental Justice

The federal government defines environmental justice (EJ) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, education level, or income with respect to the development, implementation, and enforcement of environmental laws. The MBTA monitors EJ through implementation of and reporting for Title VI of the Civil Rights Act of 1964.

The Northwest Corridor encompasses densely populated neighborhoods in Cambridge, Somerville, Arlington, Watertown, Waltham, Belmont, and Fitchburg. Parts of Cambridge, Somerville, Waltham, Leominster, and Fitchburg are classified as minority areas for Title VI, and parts of Cambridge, Shirley, Leominster, and Fitchburg are classified as both minority and low-income. Small pockets of minorities are found in Lincoln, Acton, and Harvard.

Forty-one bus routes run through this corridor; 16 are classified as minority, and two are classified as both minority and low-income.

A portion of the Red Line runs through this corridor. Four of the six Red Line stations in this corridor meet the minority station criterion, and one of these meets both the minority and low-income criterion.

The Fitchburg commuter rail line operates in the Northwest Corridor. Three commuter rail stations in this corridor meet the minority criterion, and one of these meets both the minority and low-income criteria.

MOBILITY PROBLEMS AND PROPOSED SOLUTIONS

Capacity Improvements Are Needed

Investments Will Be Needed to Ensure that Sufficient Capacity Is Available to Serve Current and Projected Travel Demand.

Problem 1:

By 2030, modeling projections suggest that growing demand on 13 bus routes in the Northwest Corridor may cause passenger crowding

levels that would trigger the need for additional service. These include:

- Bus Route 1 Harvard Station – Dudley Station via B.U. Medical Center
- Bus Route 47 Central Square, Cambridge – Broadway Station via B.U. Medical Center
- Bus Route 62 Bedford VA Hospital – Alewife Station via Lexington Center
- Bus Route 66 Harvard – Dudley Station via Harvard Street
- Bus Route 67 Turkey Hill – Alewife Station via Arlington Center
- Bus Route 68 Harvard Square – Kendall Station
- Bus Route 71 Watertown Square – Harvard bus subway via Mt. Auburn Street
- Bus Route 73 Waverly Square – Harvard bus subway via Belmont
- Bus Route 77 Arlington Heights – Bennett Street Alley
- Bus Route 86 Sullivan Station – Cleveland Circle
- Bus Route 87 Arlington Center – Lechmere Station
- Bus Route 89 Clarendon Hill – Sullivan Station
- Bus Route 554 Waverly Square – Federal and Franklin Streets.

Most of these routes operate entirely within the Northwest Corridor; however, some provide circumferential service between one or more corridors. Four of these routes also serve other corridors: bus Route 86 provides service connections between the Northwest and West Corridors; Routes 1, 47, and 66 provide connections between the Northwest, West, and Southwest Corridors; and Route 47 extends into Boston Proper as well.

Proposed Solutions:

- Purchase sufficient additional vehicles to increase peak-period capacity and to ensure that future vehicle loads do not exceed safe and comfortable levels on all of the above routes. To do so, 20 additional 40-foot buses and 11 additional electric trolley buses would be required. Replacing existing 40-foot buses and electric trolley buses with 60-foot buses and electric trolley buses would be another method for increasing capacity to meet demand.
- On bus Routes 1, 66, 71, 73, 77, 86, and 89 (Davis–Sullivan), implement bus-rapid-transit (BRT) elements, such as signal priority, cue jumps, fare prepayment, a dedicated lane, lengthened stop spacing, and improved bus stop amenities.
- The Urban Ring project would enhance circumferential service.
- Bus garage capacity in the corridor would need to be increased to house an enlarged bus fleet as service is added to meet future demand.

Problem 2:

Outside of the inner core communities of Cambridge and Somerville, Acton, Concord, and Westford show the largest projected growth in intracity travel by 2030. Of the latter three municipalities, Acton and Westford are in the service area of the Lowell Regional Transit Authority.

Proposed Solution:

Partner with local social service providers, town officials, and the Boston Region MPO to institute new demand-responsive and/or fixed-route service providing connections between densely developed residential areas in Concord and key activity hubs (including employment, commercial, and educational hubs).

Problem 3:

The transit mode share in Waltham is currently lower than would be expected (2.6% of all trips), given the existing level of bus and rail service.

Proposed Solutions:

- Increase visibility of bus services through strategies such as improving bus stop amenities and providing real-time customer information.
- Make improvements in signage and services to establish Waltham as the center of a comprehensive local bus service.

Problem 4:

Service on the Fitchburg Line currently faces frequent delays, increasing passenger travel times.

Proposed Solution:

Expand doubletracking at Newton Street in Waltham and between South Acton and Ayer. Extending the double track west through the station at South Acton would allow trains turning at South Acton to be held clear of passing trains, thus reducing delays. Station changes and signal and operational improvements may also improve operations. Station consolidation at Shirley/Ayer, Silver Hill/Hastings/Kendall Green, and Waverly/Belmont Stations could also help.

Problem 5:

Densely developed areas in Somerville currently generate high trip volumes to Cambridge and Boston. In addition, trip volumes between Somerville and Cambridge are projected to increase substantially. Taken together, these expose a gap in rapid transit service in this corridor.

Proposed Solutions:

- Extending the Green Line from Lechmere Station, in Cambridge, through Somerville to Medford would provide a transit alternative for some of the intercity travel needs within the Northwest Corridor and between the Northwest Corridor, the North Corridor, and Boston Proper.
- Implement the Urban Ring project.

Problem 6:

Traffic congestion around Alewife Station increases the running times and reduces the reliability of bus routes that serve the station.

Proposed Solution:

- Build new busways at Alewife Station.
- Extend the Red Line to Arlington via the former Lexington Branch railroad alignment.

Access to MBTA Services Needs to Be Improved

ADA Accessibility

The MBTA has made strides toward providing ADA accessibility to all of its services. However, the Fitchburg Line still has 11 stations—more than any other commuter rail line in the system—that remain inaccessible: Shirley, Ayer, Littleton/Route 495, South Acton, Concord, Lincoln, Silver Hill, Hastings, Kendal Green, Waverley, and Belmont Stations.

Proposed Solution:

Based on the feasibility of construction, the following stations (Table C-1) are a priority for near-term accessibility improvements.

TABLE C-1
Northwest Corridor
Station Accessibility Priorities

Line	Station	Priority
Fitchburg	Shirley	Low
	Ayer	Low
	Littleton/495	Planned
	South Acton	Low
	Concord	Low
	Lincoln	Low
	Silver Hill	Low (~15 boardings/day)
	Hastings	Low (~30 boardings/day)
	Kendal Green	Low
	Waverley	Low
	Belmont	Medium

Station Parking

Problem 1:

Access to rail transit services, for customers of all abilities, is constrained by the availability of parking for automobiles. An inventory of station park-

ing that was completed during the fall of 2005 and winter of 2006 shows that parking at the following stations (Table C-2) is utilized at 85% of capacity or greater.[3]

TABLE C-2
Northwest Corridor
Station Parking at 85% Usage or Greater

Line	Station
Fitchburg	North Leominster
	Littleton/Route 495
	South Acton
	Lincoln
	Shirley
	Ayer
	West Concord
	Concord
	Hastings
	Kendal Green
	Waltham
Red Line	Alewife
Green Line	Lechmere

Proposed Solution:

At stations where the MBTA is the principal provider of parking, the MBTA can address inadequate parking capacity either by increasing the number of spaces or controlling demand through measures like raising the price of parking overall or installing automated parking-fee collection at MBTA lots to allow for congestion pricing and to improve enforcement of parking regulations.

When evaluating expansion of parking, important considerations include the availability of MBTA-owned land, the potential cost of acquiring nearby land, and the potential cost of a multi-level structure. Based on these and other feasibility criteria, the following stations would have the highest potential for expansion of MBTA parking: North Leominster, Littleton/Route 495, South Acton, Lincoln, Shirley, Ayer, and Kendal Green on the Fitchburg Line.

Problem 2:

For some customers, access to rail services is constrained by the lack of bicycle parking. A recent study provided a detailed inventory of bicycle amenities, by MBTA station, that included the location, number, and condition of bike racks, bike rack shelters, and signage directing cyclists to them. The study also noted that, at some stations where bike racks were provided, cyclists did not utilize the racks, but parked their bikes elsewhere.[4]

Proposed Solution:

The study recommended that the MBTA continue to expand bicycle parking at stations; however, the MBTA does not currently have a standard for determining what the appropriate number of spaces would be for each station. The study therefore also recommended that the MBTA adopt a standard for providing bicycle parking spaces at transit stations.

- In instances where bikes were parked at locations other than at bike racks that were provided, the study made recommendations, based on the type of problem observed, including:
  - The rack was in an inconvenient location (e.g., far from the platform).
  - The rack was not sheltered from the weather.
  - The rack was in a secluded location that was difficult to find or might encourage theft.
  - The rack was damaged or difficult to use.

The following specific improvements (Table C-3) are recommended for stations at which existing bike racks were not used.[5]

Connections with Other RTAs

Problem:

The Northwest Corridor is served by one Regional Transit Authority (RTA), the Montachusett Regional

3 Fijalkowski, Jared, and Ostertog, Heather, *Inventory of Park-and-Ride Lots at MBTA Facilities*, Central Transportation Planning Staff, February 27, 2007.

4 Fijalkowski, Jared, and Yaitanes, Justin, *2005–2006 Inventory of Bicycle Parking Spaces and Number of Parked Bicycles at MBTA Stations*, Central Transportation Planning Staff, October 2, 2007, Table 6.

5 Ibid.

TABLE C-3
Northwest Corridor
Proposed Bicycle Parking Enhancements

Line	Station	Bicycle Parking Enhancement Recommendations
Red Line	Harvard	Install additional racks; install signs directing bicyclists to racks.
	Davis	Install sheltered racks.
	Kendall/MIT	Install sheltered racks at station entrances.
	Alewife	Provide shelter for existing racks.
	Central	Provide shelter for existing racks.
	Porter	Provide shelter for existing racks.
Green Line	Lechmere	Install sheltered racks at station
Fitchburg	North Leominster	Install racks.
	Kendal Green	Install racks.
	Waltham	Install sheltered racks close to platforms.
	Concord	Provide shelter for existing racks.
	Brandeis/Roberts	Provide shelter for existing racks.
Express Bus	Watertown Yard	Install signs directing bicyclists to racks.

Transit Authority (MART). Seven of MART's bus routes operate from the intermodal center at the Fitchburg commuter rail station to points in Fitchburg, Leominster, and Lunenburg. Three other routes operate only within Leominster. One additional route operates between Fitchburg and Gardner, two routes entirely in Gardner, and two routes from Gardner to Winchendon and Orange.

Although many of the bus routes operate from Fitchburg Station, the schedules are such that it would be difficult for commuters to depend on bus service to connect with commuter rail. Four of the seven routes that serve mostly Fitchburg, Leominster, and Lunenburg currently offer close connections at Fitchburg Station to one Boston-bound train in the AM peak period. However, on six of the seven routes, the last bus of the day leaves Fitchburg Station before the first outbound PM peak-period train from Boston is scheduled to arrive.

Two of the seven MART routes that serve Fitchburg Station also stop at North Leominster Station. They both offer reasonable connections to several inbound AM peak-period trains, but no connections from outbound PM peak-period trains. The three MART routes that run entirely in Leominster do not serve any commuter rail station. The route that operates between Gardner and Fitchburg provides minimal connections to commuter rail service.

Although the Northwest Corridor is served by MART, current schedules provide few close connections between MART and MBTA services. In general, RTA bus routes do not function well as commuter rail feeders since they serve different functions and populations. Most RTA routes provide local service on even headways, while commuter rail provides long-distance commuter service and operates on uneven headways due to a number of equipment and operational constraints. In addition, because RTA routes have frequent stops and many do not provide direct service to stations, using them to access stations is much slower than driving.

Proposed Solution:

Adjusting the RTA services to coordinate with commuter rail schedules would inconvenience customers making local trips. Changing the commuter rail schedules to coordinate with RTA services would require significant capital and operating costs without significantly improving service for most commuter rail riders. The best solution, therefore, would be to create specific RTA feeder services to commuter rail. It is recom-

mended that as demand for commuter rail feeder service increases, the MBTA work with MART to select one or more stations on the Fitchburg commuter rail line and to determine the number and alignment of routes that would be required to provide adequate feeder services.

Reverse-Commute Service

Problem:

There is some potential for reverse-commute service between residential areas of Boston and numerous employment destinations at industrial and office parks along Route 128 in Waltham on the Fitchburg line, which is currently the most frequently used commuter rail line for reverse commuters.[6] To attract sufficient riders to justify such service, bus or van connections from Waltham Station would need to be provided.

Proposed Solutions:

- The MBTA should work with the Route 128 Business Council TMA to enhance its shuttle service to Waltham Station with additional stops, as needed.
- Expand reverse commute options by adding outbound AM peak-period and inbound PM peak-period commuter rail trains.

Infrastructure Enhancements Are Needed

Problem:

In order to continue to maintain and improve service quality as demand grows and as technologies and materials improve, the MBTA will need to continually invest in infrastructure enhancements.

Proposed Solution :

The following enhancement projects (Table C-4) have been identified as future needs:

TABLE C-4
Northwest Corridor
Proposed Enhancement Projects

RED LINE	
Asset Category	Project Description
Communications	Install single mode fiber optic cable along the Red Line.
FITCHBURG LINE:	
Asset Category	Project Description
Power	Install a complete power system and new track layout at the Fitchburg layover facility.
Signals	Replace field code units on the Fitchburg Line with units that are compatible with the new Computer Dispatch Center so that Waltham Tower can be eliminated.
Signals	Make major improvements to the signal system on the Fitchburg Line.
Track/right-of-way	Extend the double-tracked portion of the Fitchburg Line west through the station at South Acton to reduce service delays by allowing trains turning at South Acton to be held clear of passing trains (already planned as part of MRTA project).

6 Humphrey, Thomas J., *MBTA Reverse Commuting Study*, Central Transportation Planning Staff, May 2001, pp. ES-2 and ES-5.

A State of Good Repair Needs to Be Achieved

Problem:

A number of system preservation projects must be addressed in the short- to mid-term to bring the system into a state of good repair and to ensure the safety of passengers and reliability of service.

Proposed Solutions:

Some of the specific projects needed to bring the system into a state of good repair and maintain it in that condition are included in Table C-5.

TABLE C-5
Northwest Corridor
State-of-Good-Repair Projects

RED LINE	
Asset Category	**Project Description**
Power	Replace 480 high-voltage AC cables with surface mounted systems at Harvard, Davis, and Alewife Stations on the Red Line.
Power	Replace all 125-volt DC emergency lighting systems at 10 stations on the Red Line.
Revenue vehicles	Replace Red Line cars to allow the retirement of the No. 1 fleet, which was purchased in 1969.
Track/right-of-way	Rebuild sections of the floating slab track on the Red Line between Harvard and Alewife Stations that have been in use since 1984 and are reaching the end of useful life.
Track/right-of-way	Surface and tamp the tracks and thermit weld the rail to improve the quality of service on the Red Line.
Track/right-of-way	Deactivate Red Line switches that do not meet track standards.
FITCHBURG LINE:	
Asset Category	**Project Description**
Bridges	Repair eight bridges on the Fitchburg Line that are currently rated as structurally deficient (one is in need of attention in the short- to mid-term).
Facilities	Demolish and remove building materials in the roundhouse at the Fitchburg layover facility (after abatement of asbestos at the facility).
Track/right-of-way	Replace 18.4 miles of 112-pound type, non-control-cooled rail on the Fitchburg Main Line between Willows and Fitchburg.

Appendix D West Corridor: Mobility Problems and Proposed Solutions

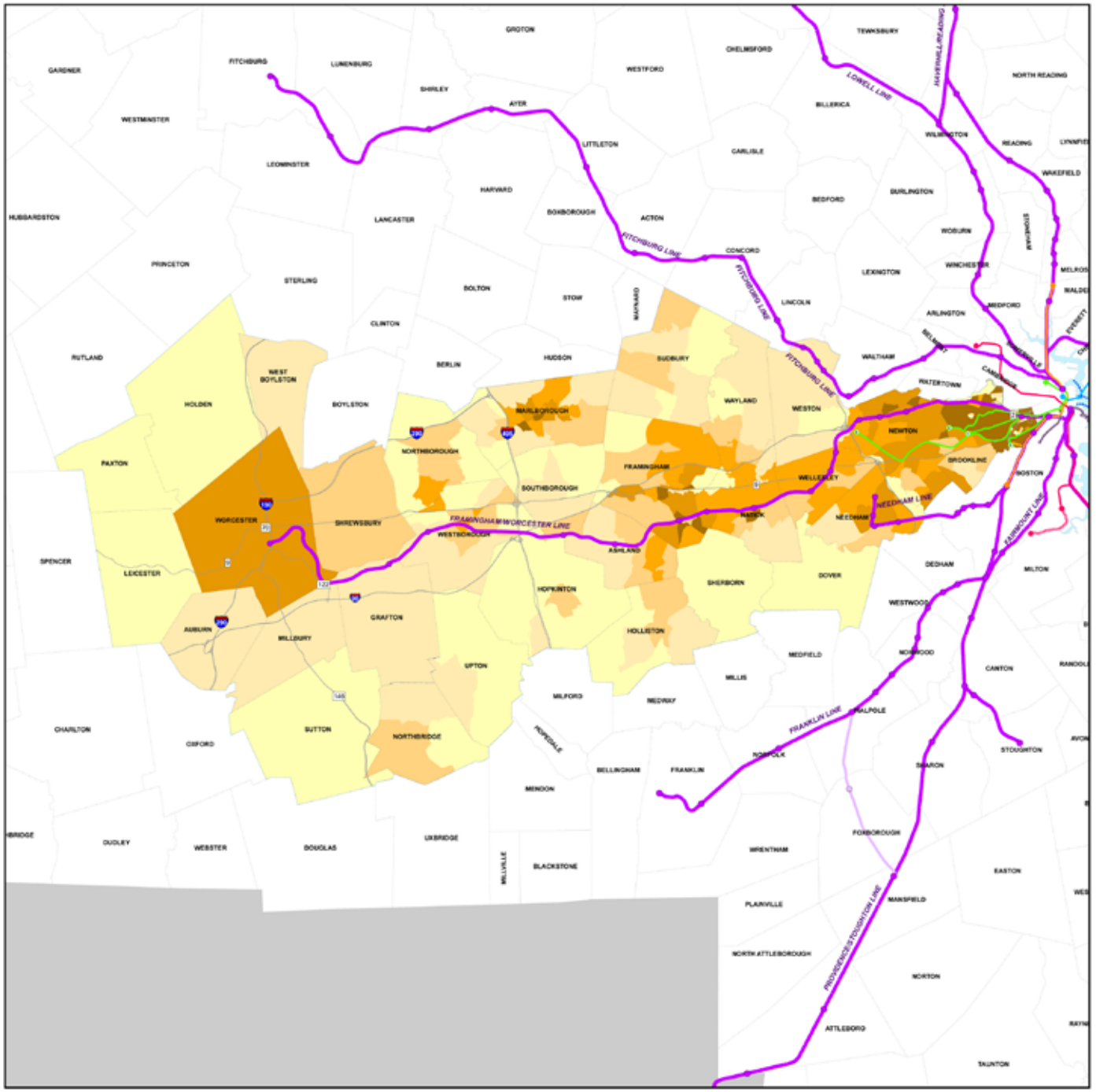
BACKGROUND

Existing Conditions

This corridor extends west from Massachusetts Avenue in Boston to the towns of Leicester and Paxton, west of Worcester, and to Auburn in the I-90 corridor. The Boston neighborhoods anchoring this corridor in the east are experiencing intense institutional expansion: the Longwood Medical and Academic Area, Boston and Northeastern Universities in the Fenway area, Harvard University in Allston, and Boston College in Brighton. In the west, Worcester, which is second largest city in New England, anchors the corridor. Most of the future development in the corridor is projected to occur in the exurbs and in Worcester.

In the West Corridor, the MBTA operates the Worcester and part of the Needham commuter rail lines. Inside of Route 128, the four Green Line branches and 11 express bus routes provide service from the suburbs into Boston. In addition, the MBTA provides local service in the corridor on 36 bus routes. Outside of Route 128 the two commuter rail lines are the principal MBTA services. Twenty trains operate in each direction on weekdays between Boston and Framingham, and 10 of these trains continue beyond Framingham and serve Worcester. Sixteen trains operate in each direction to Needham.

MBTA service in this corridor is supplemented by local bus service provided by the Worcester Regional Transit Authority (WRTA) and the MetroWest Regional Transit Authority (MWRTA). WRTA operates a bus system with 29 routes that are centered in downtown Worcester. Of these routes, 8 make



MAP D-1
West Corridor of the MBTA Service Area

Population Density, 2000

U. S. Census 2000
Population/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 176,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

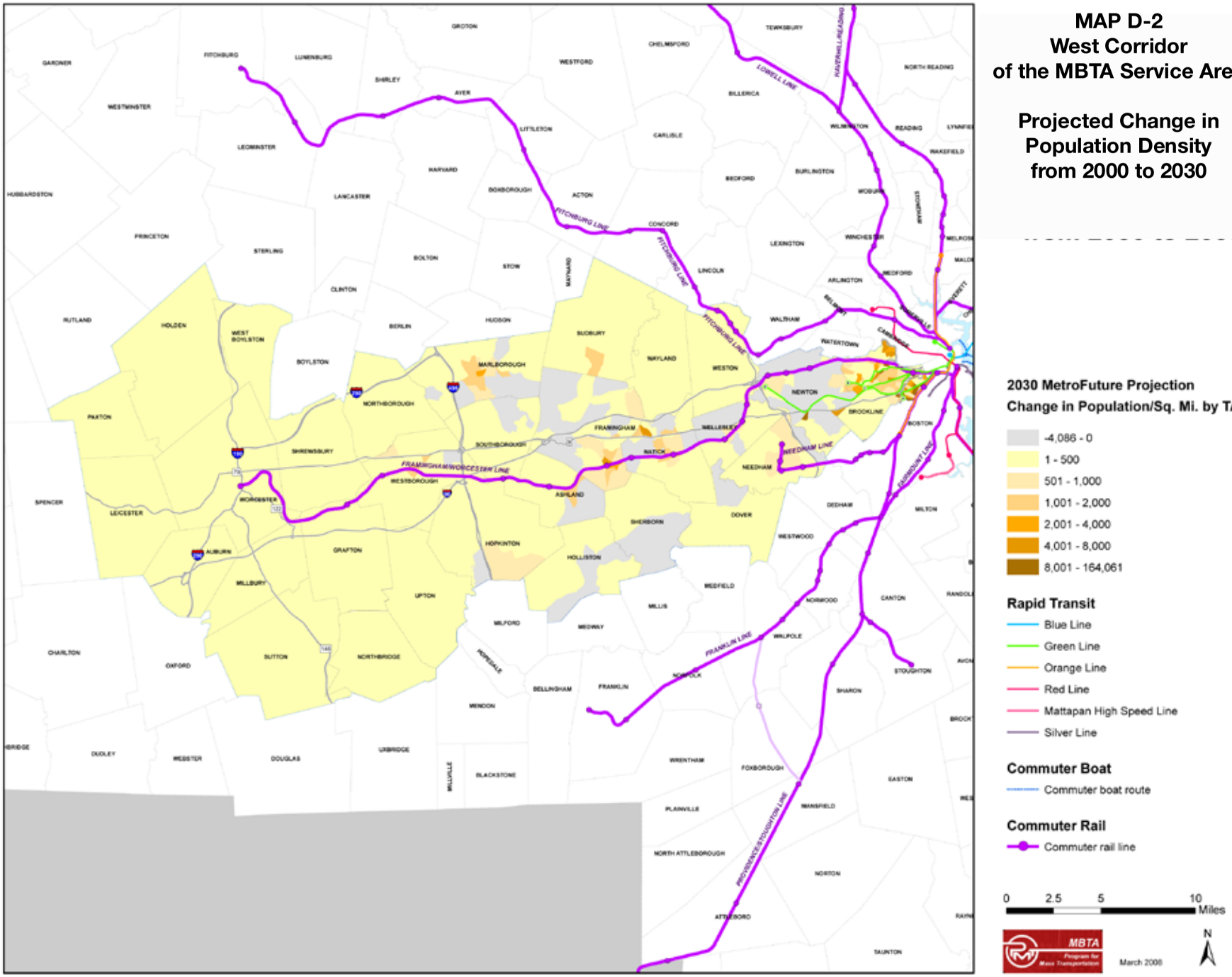
- Commuter rail line

0 2.5 5 10 Miles

N

MBTA Program for Mass Transportation

March 2008


MAP D-2
West Corridor
of the MBTA Service Area
Projected Change in
Population Density
from 2000 to 2030
2030 MetroFuture Projection
Change in Population/Sq. Mi. by TAZ
-4,086 - 0
1 - 500
501 - 1,000
1,001 - 2,000
2,001 - 4,000
4,001 - 8,000
8,001 - 164,061
Rapid Transit
Blue Line
Green Line
Orange Line
Red Line
Mattapan High Speed Line
Silver Line
Commuter Boat
Commuter boat route
Commuter Rail
Commuter rail line
0 2.5 5 10 Miles
N
MBTA
March 2008

intermediate stops at Union Station in Worcester. WRTA also provides demand-responsive service to the Southborough commuter rail station from points in Southborough and Marlborough, and is now responsible for the former Framingham LIFT and Natick Neighborhood Bus systems.

Population

In addition to three Boston neighborhoods—Longwood, Fenway, and Allston—there are 3 cities and 27 towns in this corridor. Today, the highest population densities in this corridor are found in the Boston neighborhoods, followed by Brookline and Newton, both of which are located within Route 128. Outside of Route 128, Worchester's population density is similar to Newton's (see Map D-1). By 2030, parts of Natick, Framingham, and Marlborough achieve a level of density comparable to the "close-in" suburbs. (See Map D-2.)These densely populated areas are served by commuter rail, an interstate highway, or both.

According to the U. S. Census, the corridor's 2000 population was 778,623. This population is projected to increase by 13% to 881,388 by 2030.[1] Of the six radial corridors, this has the lowest percentage increase and lowest absolute increase. The population in most communities is projected to remain stable or experience moderate growth. Sixteen of the communities are projected grow by less than 100 people per year during the 30-year period. Communities with the most projected growth include Worcester, Shrewsbury, Grafton, Framingham, and Westborough. (See Figure D-1.) All but Framingham are west of I-495.

Envisioned major housing developments include 900 units at City Square, in Worcester, and 324 units at Westborough Village, in Westborough.

FIGURE D-1
West Corridor 2000-2030
Population Growth: Top Ten Communities in Order of Increase

Employment

Current employment density patterns are similar to those for population, with the highest concentrations of employment located mostly within Route 128, and also along commuter rail lines or near major roadways, including Route 9, I-90, and I-495 (see Mad D-3). Between 2000 and 2030, employment densities are projected to remain fairly stable in most communities in this corridor, with the exception of the institutional growth in Boston and in pockets along long I-90 in Natick, Framingham, and Southborough (see Map D-4).

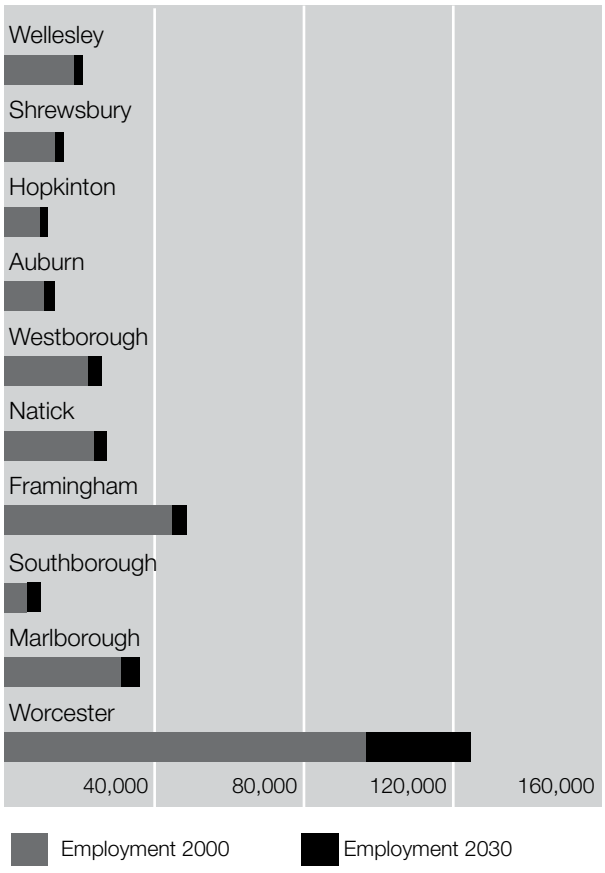
Employment in the corridor is projected to increase by 17% between 2000 and 2030, with

1 Metropolitan Area Planning Council (MAPC) and Central Massachusetts Regional Planning Commission (CMRPC) population and employment forecasts.

most communities experiencing stable or modest growth in absolute terms.[2] Two-thirds of the growth is projected to be in communities west of I-495, with 40% of total job growth occurring in Worcester alone. (See Figure D-2.)

Significant increases in employment are also expected in areas of Boston, particularly in Allston and in the Longwood Medical and Academic Area. The Longwood Medical and Academic Area, which was home to more than 40,000 employees in 2005, anticipates an increase of 1,000 new jobs annually through 2020.

FIGURE D-2
West Corridor 2000-2030
Employment Growth: Top Ten Communities in Order of Increase

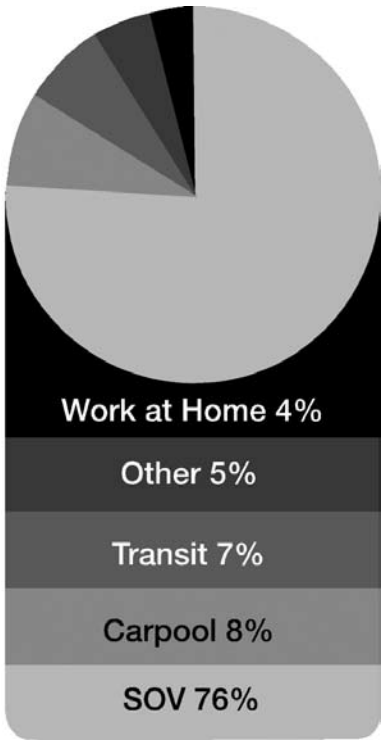


In addition to institutional expansion, there are proposed private developments in this corridor, such as Fenway Center, with close to 340,000 square feet of office space and 100,000 square feet of retail shops and restaurants. Another proposed development in the corridor is City Square, in Worcester, which along with its residential component will have one million square feet of office space and 407,000 square feet of retail space.

Journey to Work

Nationally, work trips comprise a small proportion—15 %—of all trips.[3] Because most commuting occurs during peak travel times, work-trip volumes determine the capacity needs, as well as the performance, of highway and transit systems. In 2000, of work trips that originating in the West Corridor, 76% were made in single-occupancy vehicles (SOVs); 7% were made on transit. (See Figure D-3.)

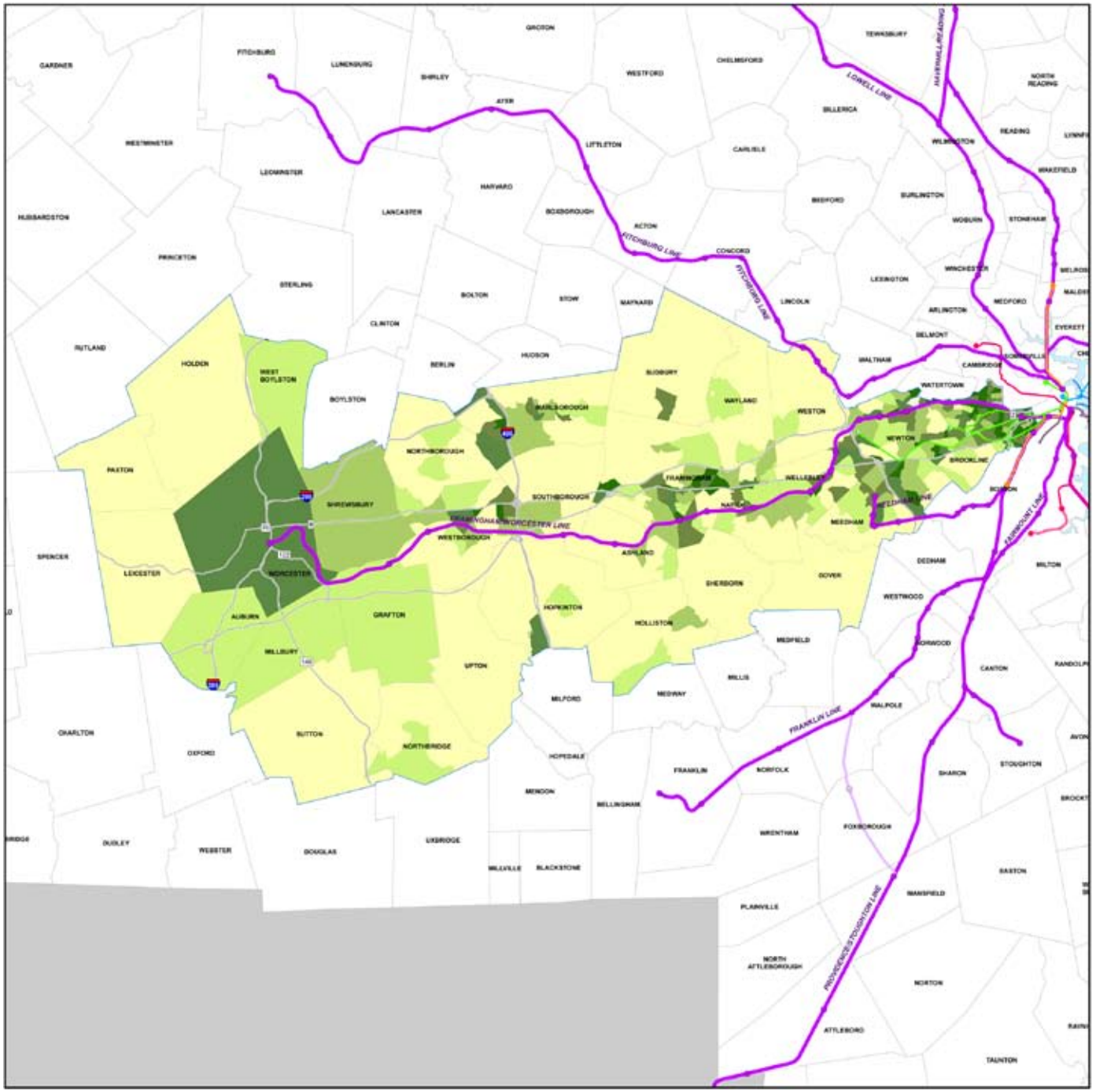
FIGURE D-3
2000 Travel Modes to Work by West Corridor Residents



Most MBTA service in the corridor is radially oriented towards Boston and Cambridge, which

2 Ibid.

3 Transportation Research Board, *Commuting in America III: The Third National Report on Commuting Patterns and Trends*, NCHRP Report 550, October 2006, p. 3.



MAP D-3
West Corridor of the MBTA Service Area

Employment Density, 2000

2000 CTPS Employment Database
Employees/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 1,000,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

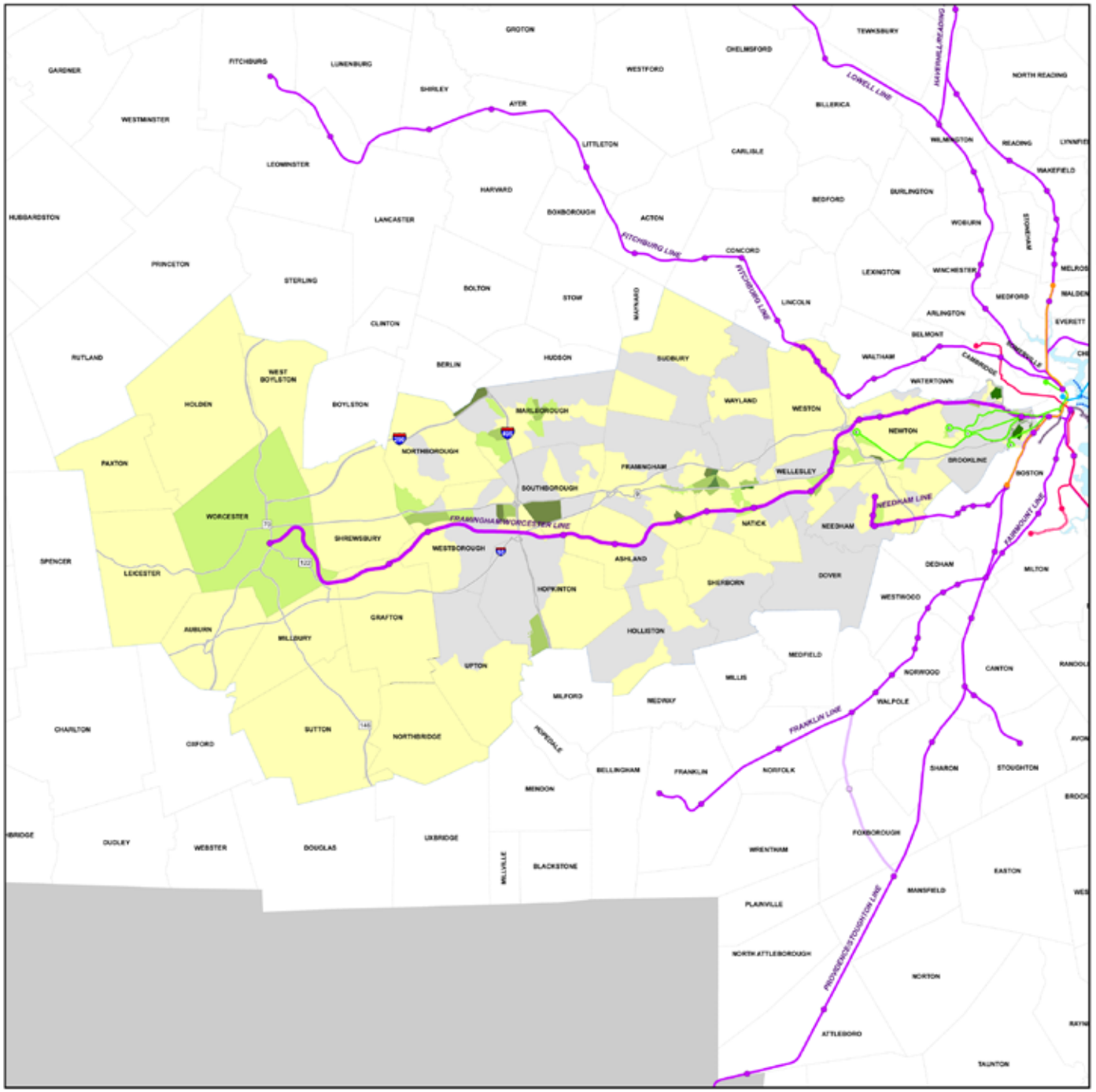
- Commuter rail line
- Special MBTA sporting events

0 1.5 3 6 Miles

N

MBTA Program for Mass Transportation

March 2008



MAP D-4
West Corridor of the MBTA Service Area

Projected Change in Employment Density from 2000 to 2030

2030 MetroFuture Projection
Change in Employees/Sq. Mi. by TAZ

- -94,000 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 400,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Mattapan High Speed Line
- Red Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 2.5 5 10 Miles

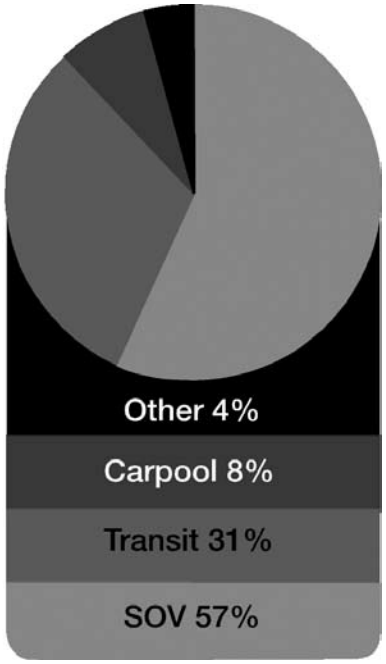
N

MBTA Programs for Mass Transportation

March 2008

together are the destination for 17% of the work trips made by corridor residents. Of these trips 56% are made in single-occupancy vehicles; 31% are transit trips. Almost two-thirds of the transit trips are from Brookline and Newton. (See Figure D-4.)

FIGURE D-4
2000 Travel Modes to Work by West Corridor Residents to Boson and Cambridge



Traffic Congestion

The Massachusetts Turnpike (I-90) is the main radial highway in this corridor. It runs to Boston from the New York border in western Massachusetts and has limited access on its entire length. Speeds average 60 mph or more between I-495 and Interchange 13 in Framingham, dropping to 50–54 mph just west of Route 128. Inbound AM peak-period average speeds then drop to 30–44 mph and continue in that range through the western half of Newton. Speeds vary on the remaining segments from there to Boston, but are mostly above 45 mph.[4] Turnpike toll reports indicate that about 68,000 vehicles each way per weekday travel through the segments of the turnpike east of Newton Corner.

The Framingham/Worcester commuter rail line serves the same corridor. Recent counts indicate that there are about 9,300 inbound riders a day on trains on this line as they leave Newton. This is equal to a 12% share of the combined person-volume on the trains and the turnpike ignoring multiple-occupancy of highway vehicles.

Travel Projections

The CTPS regional travel-demand model provides estimates of current travel volumes and projections of future travel volumes for all major modes: auto, transit, and walk/bike. A useful way of tracking travel growth patterns is to look at the change in travel between pairs of municipalities, and to include trips beginning and ending in the same municipality. By 2030, there are projected to be 37 travel pairs in the Northeast Corridor with increases of at least 1,000 two-way trips per day. The projected travel volume increase for these 37 pairs is 214,424 trips per day (approximately 23%).[5]

Of the 37 pairs with projected travel volume increases of over 1,000, 11 are for trips within or between neighborhoods in Boston or Brookline. The largest of these 11 increases are projected to be within the Longwood Medical and Academic Area (15,541), within the Fenway area (10,597), within Allston (9,964), between Fenway and Longwood (8,691), within Brookline (8,227), and within Brighton (8,198). These are all areas that will be stressed by institutional growth. Fortunately, 25% of current trips within and between these areas are made on foot, by bicycle, or via carpool, so these modes of travel is expected to absorb much, but not all, of the expected travel growth.

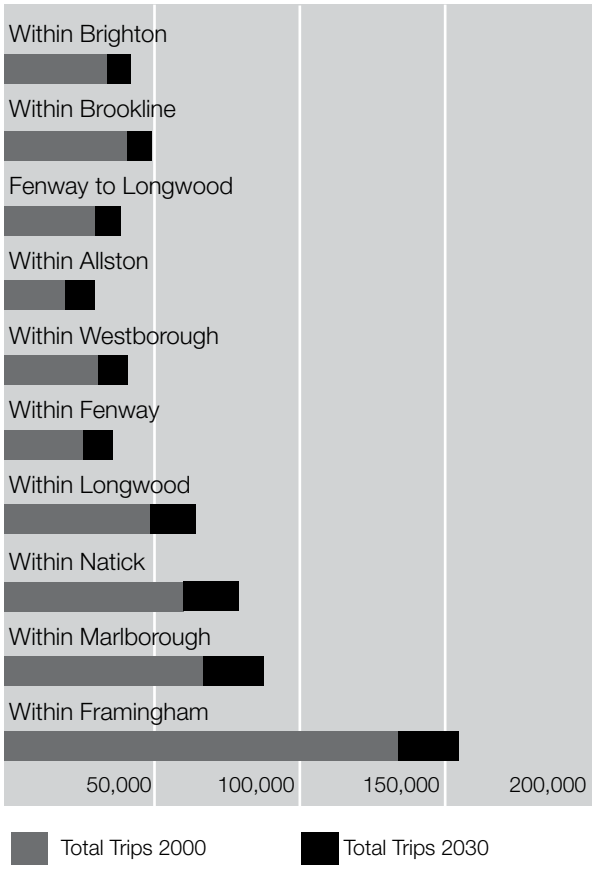
Outside of Boston and Brookline, the top three increases predicted by the model are for trip pairs that begin and end entirely within Framingham (20,932), within Marlborough (20,858), and within

4 2004 Congestion Management System (CMS) Report, Central Transportation Planning Staff, December 2004.

5 The model area does not include the city of Worcester and the nine surrounding towns that are included in the West Corridor as defined for the PMT.

Natick (18,906). (See Figure D-5.) All three of these are currently served by local bus routes that have recently been taken over by MWRTA. Again, it should be noted that the model area does not include Worcester or the nine towns surrounding it.

FIGURE D-5
West Corridor Trip Increases 2000-2030: Top Ten in Order of Increase



The model also predicts 18 travel pairs increases of over 1,000 daily trips between points in the West Corridor and points in other PMT corridors, including 9 with the Northwest Corridor, 8 with the Southwest Corridor, and 1 with Boston Proper. The largest of these are trips between the Fenway and Boston Proper (7,153), between Newton and Waltham (5,375), between Cambridge and Allston (4,527), between Newton and Watertown, (3,561), between the Fenway and Roxbury (3,113), and between the Longwood Medical and Academic Area and Roxbury (2,737). The predicted increases for each of the other 12 pairs are all below 1,800.

Environmental Justice

The federal government defines environmental justice (EJ) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, education level, or income with respect to the development, implementation, and enforcement of environmental laws. The MBTA monitors EJ through implementation of and reporting for Title VI of the Civil Rights Act of 1964.

The West Corridor encompasses several of Boston's densely populated neighborhoods: Allston, Brighton, Fenway, and Longwood. All of Allston, Fenway, and Longwood, as well as parts of Brighton, are classified as minority areas for Title VI, and parts of these neighborhoods are also classified as low-income. Three other municipalities in the West Corridor—Brookline, Framingham, and Worcester—contain a number of census tracts that are classified as minority. Framingham and Worcester also have tracts that are classified as low-income or both minority and low-income. Only small pockets of minority areas exist in other municipalities in the West Corridor. Marlborough, Westborough, and Grafton each include a small area that is minority but not low-income.

Seventeen bus routes run through this corridor; five are classified as minority, and one of these is classified as both minority and low-income

Portions of all four branches of the Green Line operate in this corridor. Twenty-seven of the Green Line stations in this corridor are classified as minority, and 15 of these stations are also classified as low-income.

The Worcester commuter rail line operates in this corridor. Three commuter rail stations in this corridor meet the minority station criterion; one of these meets the criteria for both minority and low-income.

MOBILITY PROBLEMS AND PROPOSED SOLUTIONS

Capacity Improvements Are Needed

Investments Will Be Needed to Ensure that Sufficient Capacity Is Available to Serve Current and Projected Travel Demand.

Problem 1:

As indicated above, by 2030 the largest growth in intracity trips is projected for Framingham, Marlborough, and Natick. As indicated above, local transit service in Marlborough is provided by the WRTA, and Framingham and Natick recently joined the MWRTA. Of the remaining cities and towns outside of Boston that are not served by another RTA and that have limited or no existing local bus service, Needham and Wellesley have the largest numbers of current and projected intracity trips in the corridor.

Proposed Solutions:

- Create a new branch of the Riverside (D Branch) Green Line from near Eliot Station to Neeham Junction on the unused freight line alignment, with a new stop in Newton and stops at the existing Needham Heights and Needham Center commuter rail stops. Needham commuter rail service could then end at Needham Junction.
- Partner with local social service providers, town officials, and the Boston Region MPO to institute new demand-responsive and/or fixed-route service that would connect densely developed residential areas in Wellesley and Needham with key activity hubs (including employment, commercial, and educational hubs).

Problem 2:

The Green Line Central Subway is currently operating at capacity, constraining the ability of the system to meet growth in demand for service within the West Corridor. In addition, by 2030 ridership demand on the Green Line's C, D, and E Branches, as well as in the Central Subway, is projected to exceed capacity if two-car trains are still in use.

Proposed Solutions:

- Implement operation of three-car trains and ITS technologies.
- Add a crossover track at Park Street Station.
- Implement the Urban Ring project.

Problem 3:

By 2030, modeling projections suggest that four bus routes in the West Corridor may cause passenger-crowding levels that would trigger the need for additional service. These include:

- Bus Route 64 Oak Square – University Park or Kendall/MIT
- Bus Route 65 Brighton Center – Kenmore Station
- Bus Route 66 Harvard – Dudley Station via Harvard Street
- Bus Route 503 Brighton Center – Copley Square (Express)

Bus Route 66 provides circumferential service between the West, Northwest, and Southwest Corridors (see the discussions in the Northwest and Southwest Corridor problem statements).

Proposed Solutions:

- To increase peak-period capacity and to ensure that crowding does not exceed safe and comfortable levels, nine additional 40-foot buses would be required to operate these routes. Replacing existing 40-foot buses with 60-foot buses would be another method for increasing capacity to meet demand. (Bus Route 66 also operates in the Northwest and Southwest Corridors; it is discussed in those problem statements as well.)
- On Route 66, implement BRT elements, such as signal priority, cue jumps, fare prepayment, a dedicated lane, lengthened stop spacing, and improved bus stop amenities, to improve circumferential connections.

Problem 4:

The tracks on which the Framingham/Worcester Line operates are owned by CSX, which runs freight service and controls train dispatch for both freight and commuter rail. On-time performance has been problematic on the Framingham/ Worcester Line, primarily due to conflicts with freight service and lack of MBTA control over dispatching on the line. In addition, by 2030 this line is projected to be operating at close to capacity.

Proposed Solutions:

- Operate eight- to nine-car trainsets and improve track, signal, and dispatch capacity to increase throughput and reduce conflicts with freight service.
- Purchase CSX-owned tracks west of Framingham to allow for capacity expansion to accommodate growth in both freight rail and commuter rail service between Union Station in Worcester and South Station in Boston. Increasing capacity west of Framingham would allow consideration of further expansion in the existing right-of-way to Springfield.
- Double-track approximately three miles between South Station and Beacon Yard to decrease the potential for delays and increase service capacity.
- Add new commuter rail service from Worcester via freight tracks through West Boylston, Sterling, Clinton, Lancaster, and Harvard to Ayer on the Fitchburg Line. This would provide an opportunity for increased service between Worcester and Boston, as well as providing service in the newly served towns. However, the rail distance from Worcester to Boston is 20 miles longer via Ayer than via Framingham.

Problem 5:

Fenway/Longwood Medical and Academic Area is both a prominent tourist/cultural destination and a growing center for employment in the Boston region. Congestion of the transportation system in this area constrains growth and economic development potential.

Proposed Solutions:

- Implement the Urban Ring project with a tunnel through the Longwood Medical and Academic Area.
- Upgrade Yawkey Station.

Problem 6:

Bus Route 57 is a heavily used Key Route between Watertown and Kenmore Square.

Proposed Solution:

Implement BRT elements to establish this route as a premium radial bus service.

Problem 7:

Harvard and Boston Universities are planning major development adjacent to the Worcester commuter rail line.

Proposed Solution:

Add a new station on the Worcester commuter rail line in Allston or another location in the area.

Access to MBTA Services Needs to Be Improved

ADA Accessibility

Problem:

Although the MBTA has made strides toward providing ADA accessibility to all of its services, some gaps still remain. On the Framingham/ Worcester commuter rail line, Natick, Wellesley Square, Wellesley Hills, Wellesley Farms, Auburndale, West Newton, and Newtonville stations/ stops have not yet been made accessible.

Many challenges remain on the Green Line, with only 26 of 66 stations/stops currently accessible. In addition, Green Line trains operate with a mix of low- and high-floor cars. At all accessible stations, a bridge plate is used to board low-floor cars, but at 4 of the accessible surface stations, a portable lift is also necessary. Boarding high-floor cars

requires the use of mini-high platforms or mobile lifts at all accessible stations.

Green Line stations that are not yet accessible and do not currently have funding programmed for accessibility improvements include:

- Green Line B Branch: Blandford Street, BU West, St. Paul Street, Pleasant Street, Babcock Street, Packard's Corner, Brighton Avenue, Griggs Street, Allston Street, Warren Street, Sutherland Road, Chiswick Road, Chestnut Hill Avenue, South Street
- Green Line C Branch: Hawes Street, Kent Street, St. Paul Street, Summit Ave., Brandon Hall, Fairbanks, Tappan Street, Dean Road, Englewood Avenue
- Green Line D Branch: Waban, Eliot, Newton Highlands, Chestnut Hill, Beaconsfield
- Green Line E Branch: Fenwood Road, Mission Park/Parker Hill, Riverway, Back of the Hill. All of these E Line stops are along the section where tracks are directly in the street, so making them accessible will present a challenge.

Proposed Solution:

Based on the feasibility of construction, the following stations in Table D-1 are a priority for accessibility improvements.

TABLE D-1
West Corridor
Station Accessibility Priorities

Line	Station	Priority
Framingham	Natick	Medium
	Wellesley Square	Medium
	Wellesley Hills	Medium
	Wellesley Farms	Medium
	Auburndale	Medium
	West Newton	Medium
	Newtonville	Medium
Green Line B	Blandford Street	High
	BU West	High
	St. Paul Street	High
	Packard's Corner	
	Pleasant Street	High
	Babcock Street	High
	Griggs Street/Long Avenue	Medium
	Allston Street	Medium
	Warren Street	Medium
	Sutherland Street	Medium
	Cheswick Road	Medium
	Chestnut Hill Avenue	Medium
	South Street	Low
Green Line C	Hawes Street	Low
	Kent Street	Medium
	St. Paul Street	Medium
	Summit Ave	Medium
	Brandon Hall	Low
	Fairbanks	Medium
	Tappan Street	Medium
	Dean Road	Low
	Englewood Avenue	Medium
Green Line D	Beaconsfield	Medium
	Chestnut Hill	Medium
	Newton Highlands	High
	Eliot	Medium
	Waban	Low

Station Parking

Problem 1:

Access to rail transit services, for customers of all abilities, is constrained by the availability of automobile parking. An inventory of station parking that was completed during the fall of 2005 and winter of 2006 shows that parking at the following stations is utilized at 85% of capacity or greater.[6] (See Table D-2.)

TABLE D-2
West Corridor
Station Parking at 85% Usage or Greater

Line	Station
Needham Line	Needham Junction
	Needham Center
Worcester Line	Natick
	Auburndale
	Framingham
	Grafton
	Worcester
	Westborough
	West Natick
	Wellesley Square
	Southborough
	Wellesley Hills
	West Newton
Green Line D Branch	Waban
	Eliot
	Chestnut Hill

Proposed Solution:

The MBTA can address inadequate parking capacity either by increasing the number of spaces or controlling demand through measures like increasing the price of parking overall or installing an automated parking-fee collection system at MBTA lots to allow for congestion pricing and to improve enforcement of parking regulations.

When evaluating expansion of parking, it is important to consider the availability of MBTA-owned land, the potential cost of acquiring nearby land, and the potential cost of a multilevel structure. Based on these and other feasibility criteria, the following stations have potential for expansion of MBTA parking: Needham Junction and Needham Center on the Needham Line; and Grafton, Westborough, Southborough, Framingham, West Natick, Natick, Wellesley Square, and Auburndale on the Framingham/Worcester Line.

Problem 2:

For some customers, access to rail services is constrained by the lack of bicycle parking. A recent study provided a detailed inventory of bicycle amenities, by MBTA station, that included the location, number, and condition of bike racks, shelters, and signage.[7]

Proposed Solution:

The study recommended that the MBTA continue to expand bicycle parking at stations; however, the MBTA does not currently have a standard for determining what the appropriate number of spaces would be for each station. The study therefore also recommended that the MBTA adopt a standard for providing bicycle parking spaces at transit stations.

In instances where bikes were parked at locations other than at bike racks that were provided, the study made recommendations, based on the type of problem observed, including:

- The rack was in an inconvenient location (e.g., far from the platform).
- The rack was not sheltered from the weather.
- The rack was in a secluded location that was difficult to find or might encourage theft.
- The rack was damaged or difficult to use.

The following specific improvements are recommended for stations at which existing bike racks were not used.[8] (See Table D-3.)

6 Fijalkowski, Jared, and Ostertog, Heather, *Inventory of Park-and-Ride Lots at MBTA Facilities*, Central Transportation Planning Staff, February 27, 2007.

7 Fijalkowski, Jared, and Yaitanes, Justin, *2005–2006 Inventory of Bicycle Parking Spaces and Number of Parked Bicycles at MBTA Stations*, Central Transportation Planning Staff, October 2, 2007, Table 6.

8 Ibid.

TABLE D-3
West Corridor
Bicycle Parking Improvements

Line	Station	Recommendation
Green Line D Branch	Brookline Village	Install additional racks close to platforms.
	Newton Centre	Install sheltered racks close to platforms.
	Woodland	Provide shelter for existing racks.
	Eliot	Relocate existing racks closer to platform.
Framingham/Worcester	Wellesley Square	Relocate existing rack to location visible from the street.
	Wellesley Hills	Install racks.
	Wellesley Farms	Relocate existing racks.
	Worcester	Install signs directing bicyclists to racks.
	Natick	Install signs directing bicyclists to racks.
	Westborough	Relocate rack so that no spaces are blocked by the shelter.
Needham Line	Needham Center	Provide shelter for existing racks.

Connections with Other RTAs

Problem:

Access to MBTA commuter rail stations could potentially be provided through local bus services provided by other Regional Transit Authorities (RTAs). Such services might be a viable alternative to increases in station parking.

The West Corridor is served by two RTAs that provide connections to MBTA commuter rail stations. However, most of the RTA services in the West Corridor are intended primarily for purposes other than commuter rail transfers, and do not allow many close connections to or from trains.

The Worcester Regional Transit Authority (WRTA) operates a bus system of 29 routes that is centered in downtown Worcester at Worcester City Hall. Worcester Union Station, the outer terminal of the MBTA's Worcester commuter rail line, is about one-half mile from City Hall, and the walking path requires crossing several heavily traveled roads. Currently, eight of the bus routes make intermediate stops at Union Station; however, a proposal is currently pending that would discontinue one of the eight. Among all of the trips on the eight routes that currently stop at Union Station, only two have scheduled connections of 10 minutes or less to inbound AM-peak-period trains. Six trips have scheduled connections of 10 minutes or less from outbound PM-peak-period trains.

The MetroWest Regional Transit Authority (MWRTA) was formed in 2007 and took over operation of the Framingham LIFT and the Natick Neighborhood Bus (NNB) systems. It is anticipated that a current study will propose some restructuring of the MWRTA routes.

The former LIFT system consists of five minibus routes that radiate from the Framingham Downtown Common opposite the intersection of Concord and Howard streets, which is located approximately 700 feet from the MBTA's Framingham commuter rail station. Two of these five routes stops at the Framingham commuter rail station. A sixth LIFT route does not serve downtown Framingham directly.

Connections inbound from the bus to train service and outbound from the train to the bus are available on most of the former LIFT routes, but most involve waiting times of at least 15 minutes. A 2003 passenger survey of passengers on all LIFT routes found a total of 17 customers transferring inbound from the bus to the train on two routes. In addition, one route had 19 outbound reverse-

commute transfers from the train to the bus.

Three of the MWRTA's current routes, one of which is a shuttle that is designed to provide commuter rail connections at Natick Station, formerly composed the NNB. In addition, the MWRTA took over a demand-responsive service from the WRTA. This service provides connections to the Southborough commuter rail station from points in Southborough and Marlborough. Users of this service must place requests for service no later than 1:00 PM on the day preceding the trip and are picked up within a specified 20-minute interval. For those going to or from Southborough Station, travel times could be expected to vary depending on the number of passengers who board and alight at other locations.

Although the West Corridor is served by both the WRTA and MWRTA, current schedules provide few close connections between RTA and MBTA services. In general, RTA bus routes do not function well as commuter rail feeders, as they serve different functions and populations. Most RTA routes provide local service on even headways, while commuter rail provides long-distance commuter service and operates on uneven headways due to a number of equipment and operational constraints. In addition, because RTA routes have frequent stops and many do not provide direct service to stations, using them to access stations is much slower than driving.

Proposed Solution:

Adjusting the RTA services to meet the commuter rail schedules would inconvenience customers making local trips. Changing the commuter rail schedules to coordinate with RTA services would require significant capital and operating costs without significantly improving service for most commuter rail riders. The best solution, therefore, would be to create RTA feeder services to commuter rail. It is recommended that as demand for commuter rail feeder service increases, the MBTA work with WRTA and MWRTA to select one or more stations on the Framingham/Worcester Line and to determine the number and alignment of routes that would be required to provide adequate feeder services.

The 2003 PMT evaluated and recommended one possible commuter rail feeder route that would operate from the southeast side of Ashland to Ashland Station, which does not currently have bus connections.

Reverse-Commute Service

Problem:

In the West Corridor, there is some potential for reverse-commute service between residential areas of Boston and employment sites in Wellesley and Framingham, on the Framingham/Worcester Line, and in Needham, on the Needham Line. Wellesley, Framingham, and Needham are among the top 10 municipalities in the region for attracting employees from Boston. Some potential also exists on the Framingham Line for attracting reverse-commute trips to employment sites in Marlborough from Southborough Station in the I-495 corridor.[9] To attract sufficient riders to justify any of these services, bus or van connections from stations to employment sites would need to be provided.

Proposed Solutions:

- The MBTA should work with the Route 128 Business Council Transportation Management Association (TMA) to provide shuttle service to commuter rail in Wellesley and Needham, and with the MetroWest/495 TMA to provide shuttle service to Southborough Station from Marlborough employment sites.
- Expand reverse commute options by adding outbound AM-peak-period and inbound PM-peak-period commuter rail trips.

9 Humphrey, Thomas J., *MBTA Reverse Commuting Study*, Central Transportation Planning Staff, May 2001, pp. ES-2 and ES-5.

INFRASTRUCTURE ENHANCEMENTS ARE NEEDED

Problem:

In order to continue to maintain and improve service quality as demand grows and as technologies and materials improve, the MBTA will need to continually invest in infrastructure enhancements.

Proposed Solution:

The following infrastructure enhancement projects in Table D-4 have been identified as future needs:

TABLE D-4
West Corridor
Infrastructure Enhancement Projects

GREEN LINE	
Asset Category	**Project Description**
Communications	Install single-mode fiber-optic cable along the Green Line.
Revenue vehicles	Procure additional Green Line vehicles, if needed, to operate service extension to Somerville and Medford (not directly an issue for the West Corridor).
Signals	Evaluate the use of Communication-Based Train Control (CBTC) for the Green Line.
Technology	Add Auto Vehicle Identifier (AVI) technology to Green Line vehicles and tie into the Operations Control Center to facilitate better control over the spacing, flow, and speed of Green Line trains.
FRAMINGHAM/WORCESTER LINE	
Asset Category	**Project Description**
Maintenance facilities	Construct additional midday storage for commuter rail trains used in south-side commuter rail operations.
Power	Install ventilation fans at the Worcester Line layover facilities.
Signals	Implement improvements to the signal system along the Framingham/Worcester Line corridor.

A STATE OF GOOD REPAIR NEEDS TO BE ACHIEVED

Problem:

A number of system preservation projects must be addressed in the short- to mid-term to bring the system into a state of good repair and to ensure the safety of passengers and reliability of service.

Proposed Solution:

Some of the specific projects needed to bring the system into a state of good repair and maintain it in that condition are included in Table D-5.

TABLE D-5
West Corridor
State-of-Good-Repair Projects

GREEN LINE	
Asset Category	**Project Description**
Bridges	Repair one bridge on the Green Line D Branch that is currently rated as structurally deficient.
Maintenance facilities	Replace and overhaul doors and overhead doors at the Green Line Reservoir facility on an as-needed basis, and perform minor repairs to the brick exterior.
Signals	Replace signals on the Green Line D Branch, including the Reservoir Yard.
Power	Upgrade the DC negative return system on the Green Line.
Power	Remove existing heavy-section insulators and replace them with new, lightweight, state-of-the-art-design double-beam section insulators on the entire Green Line.
Power	Refurbish the substation buildings and replace all the internal operating equipment at Riverside and Reservoir, and only internal operating equipment at 45 High Street. Upgrade the Riverside substation.
Power	Completely replace the Green Line overhead catenary systems on Commonwealth Avenue, the Lake Street Yard near Boston College, the Reservoir Yard, and Huntington Avenue.
Power	Install two AC cables on the Green Line from the Coolidge substation to Reservoir substation; replace track switches, controls, and heaters along the Green Line; and upgrade the DC cable feed from Oak Square to Watertown Square.
Power	Upgrade all Green Line vent shaft AC cables to accommodate increased loading.
Signals	Make incremental updates/replacements to Green Line signal equipment technology, including interlocking logic, track circuits signaling, and switch heater controls.
Track/right-of-way	Reconstruct/rehabilitate 37 Green Line grade crossings.
Track/right-of-way	Install new wood ties along the B and C Branches of the Green Line.
Track/right-of-way	Green Line tracks need continuous inspection and work to support the low-floor cars, and the ties need to be replaced on the B and C Branches.
FRAMINGHAM/WORCESTER LINE	
Asset Category	**Project Description**
Power	Replace 60 pole-mounted lighting fixtures at three Framingham/Worcester Line stations in Newton.
NEEDHAM LINE	
Asset Category	**Project Description**
Bridges	Repair one bridge on the Needham commuter rail line that is currently rated as structurally deficient.

Appendix E Southwest Corridor: Mobility Problems and Proposed Solutions

BACKGROUND

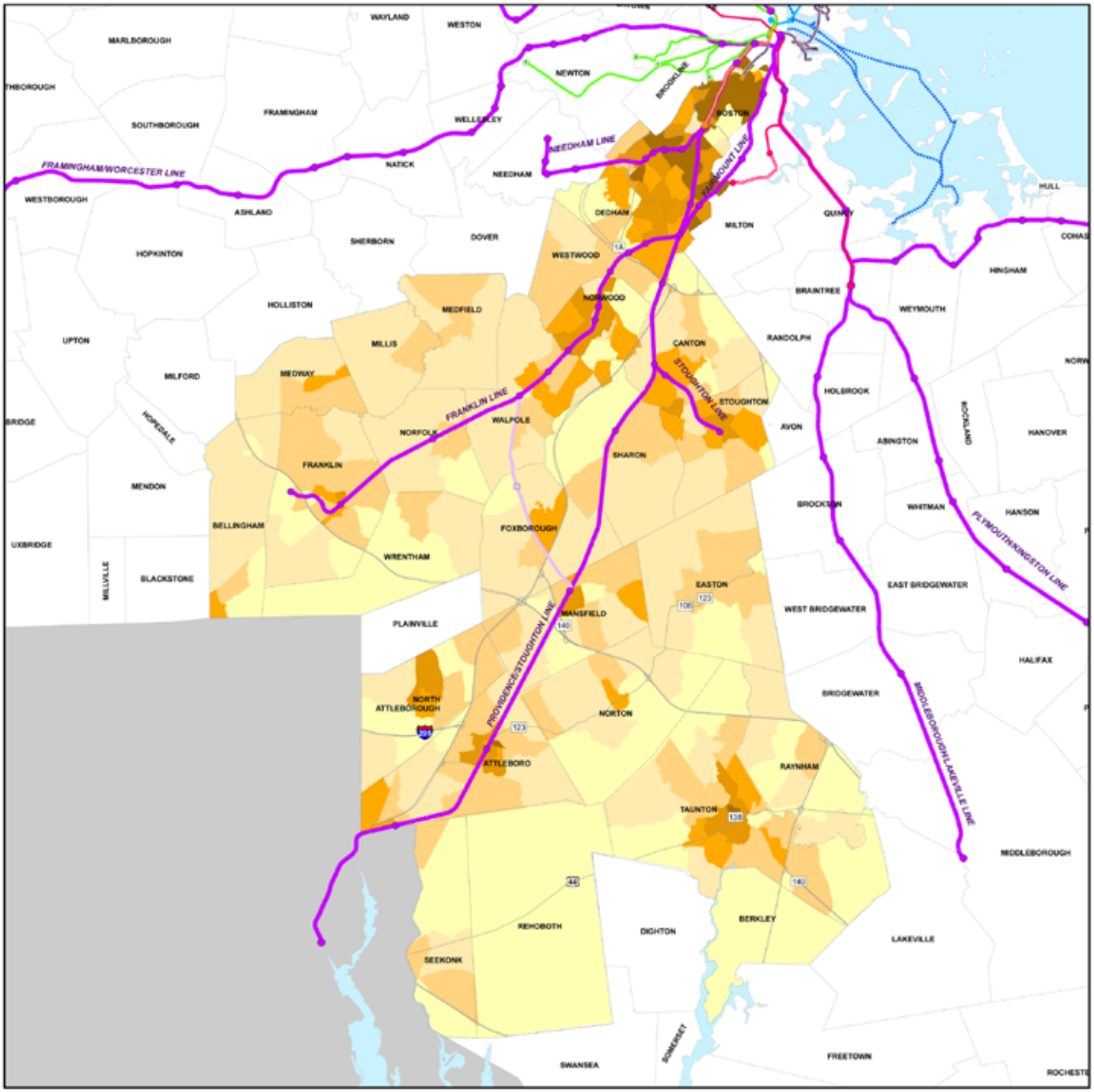
Existing Conditions

The Southwest Corridor begins with the Boston neighborhoods of Roxbury, Jamaica Plain, Roslindale, West Roxbury, and Hyde Park. From Boston the sector extends to Rhode Island and includes two cities and 23 towns.

The MBTA operates commuter rail, rapid transit, bus rapid transit, express bus routes, and 40 local bus routes in the corridor. Two commuter rail lines operate entirely within this corridor: the Franklin, Providence/Stoughton Lines. The Providence/Stoughton Line traverses the entire corridor and serves riders from Rhode Island. Parts of the corridor are also served by the Needham and Fairmount Lines.

Two MBTA rapid transit lines reach into the Southwest Corridor. The Silver Line bus rapid transit service goes from Boston Proper to Dudley Square, and the Orange Line has six stations in the corridor, including the major bus hubs of Ruggles and Forest Hills Stations. A number of local bus routes are centered on Dudley Square and Ruggles Station and serve the Southwest Corridor as well as adjacent corridors. A number of bus routes radiate from Forest Hills Station as well, serving Boston neighborhoods in this corridor as well as in Dedham, Westwood, Norwood, and Walpole.

In addition to the MBTA, the Greater Attleboro Taunton Regional Transit Authority (GATRA) provides bus services connecting with the Attleboro, South Attleborough, and Mansfield Stations on the Providence/Stoughton commuter rail line, and with Franklin Station on the Franklin Line. GATRA is responsible for several separate bus route networks. Seven GATRA routes serve Attleboro, and some of these extend into other municipalities. All but one of these routes serve downtown Attleboro.



MAP E-1
Southwest Corridor of the MBTA Service Area

Population Density, 2000

U. S. Census 2000
Population/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 176,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

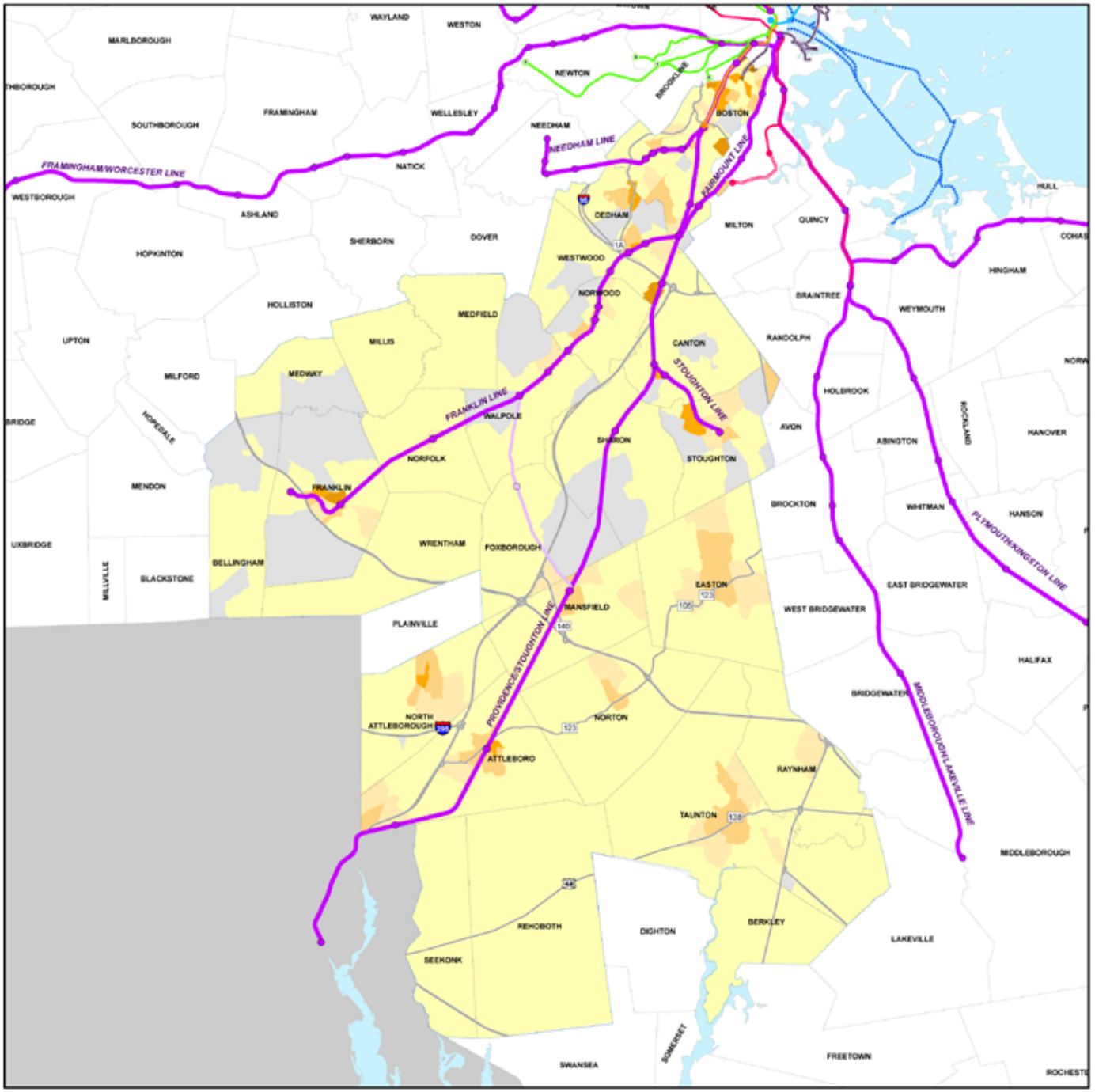
- Commuter rail line

0 2 4 8 Miles

N

MBTA Program for Mass Transportation

March 2008



MAP E-2
Southwest Corridor of the MBTA Service Area

Projected Change in Population Density from 2000 to 2030

2030 MetroFuture Projection
Change in Population/Sq. Mi. by TAZ

- -4,086 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 164,061

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 1.5 3 6 Miles

MBTA Program for Mass Transportation

March 2008

N

Brockton Area Transit (BAT) provides a bus route connecting with Stoughton Station on the Stoughton branch of the Providence/Stoughton commuter rail line. Also, the Medway Council on Aging operates a bus service connecting with Norfolk Station on the Franklin Line.

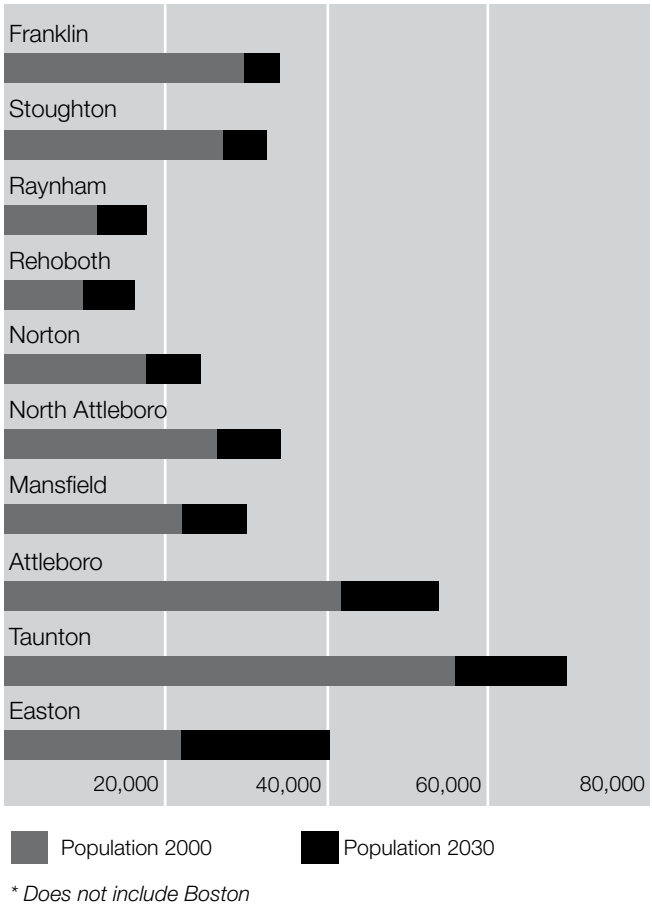
Population

The most densely populated areas of the corridor are the Boston neighborhoods. Parts of some other communities have densities similar to Boston's, usually near a commuter rail stop. North Attleborough and Taunton also have densely populated sections (see Map E-1). The majority of corridor communities are projected to experience little or no change in population density between 2000 and 2030, with the largest changes expected in Boston or close to commuter rail stations in Westwood, Franklin, and Stoughton (see Map E-2).

According to the U. S. Census, the corridor's 2000 population was 1,090,303. This population is projected to increase by 21%, to 1,314,062, by 2030.[1] In 2000, more than half of the population (592,398) in the corridor lived in the Boston neighborhoods that are included in the Southwest Corridor. By 2030, the Boston population in the corridor is projected to grow by almost 20%, to 699,174. Although the other communities will grow by 23%, they will still constitute less than half of the corridor population. Outside of Boston, 38% of the population increase is expected in only three communities: Easton, Taunton, and Attleboro. (See Figure E-1.)

Examples of large housing developments proposed or in the permitting process include 1,000 new homes in Westwood, adjacent to Route 128 Station on the Providence/Stoughton commuter rail line, and 730 units in Jamaica Plain, adjacent to Forest Hills Station on the Orange Line.

FIGURE E-1
Southwest Corridor 2000-2030
Population Growth: Top Ten Communities* in Order of Increase



** Does not include Boston*

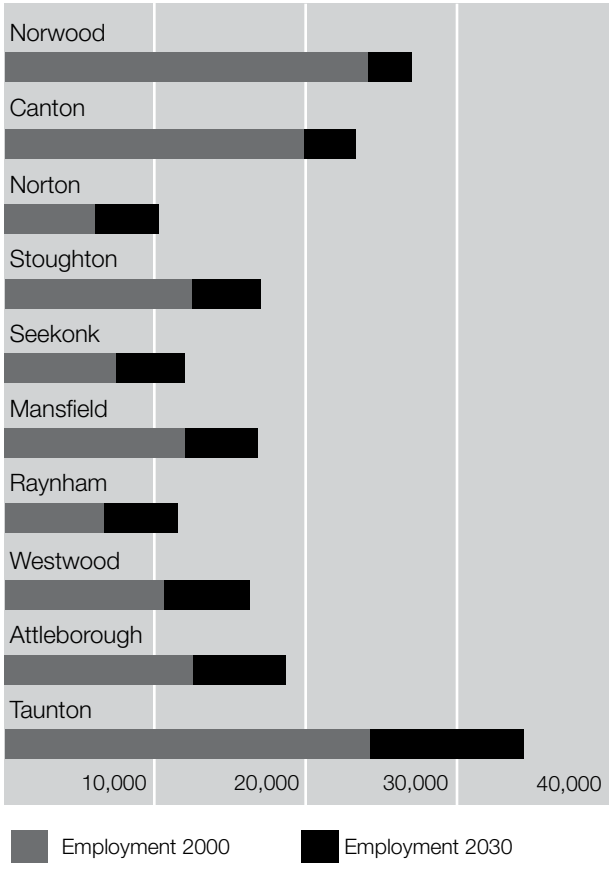
Employment

As with population, the highest employment densities in the corridor generally occur in communities closest to Boston and in communities along commuter rail. Corridor city Taunton lies outside I-495 and is not currently served by commuter rail, but also has high employment density (see Map E-3). Although some communities are projected to experience some degree of density change, the majority are projected to experience little or no change between 2000 and 2030. (See Map E-4.)

1 Metropolitan Area Planning Council (MAPC), Old Colony Planning Council (OCPC), and Southeastern Regional Planning and Economic Development District (SRPEDD) population and employment forecasts.

Overall, employment in the corridor is projected to increase by 19% between 2000 and 2030. Boston, which is projected to increase by 15%, accounts for almost half of the total growth in the corridor.[2] The communities outside of Boston will grow by 26%. Approximately 41% of all of the corridor growth outside of Boston will occur in communities outside of I-495. (See Figure E-2.)

FIGURE E-2
Southwest Corridor 2000-2030
Employment Growth: Top Ten Communities in Order of Increase

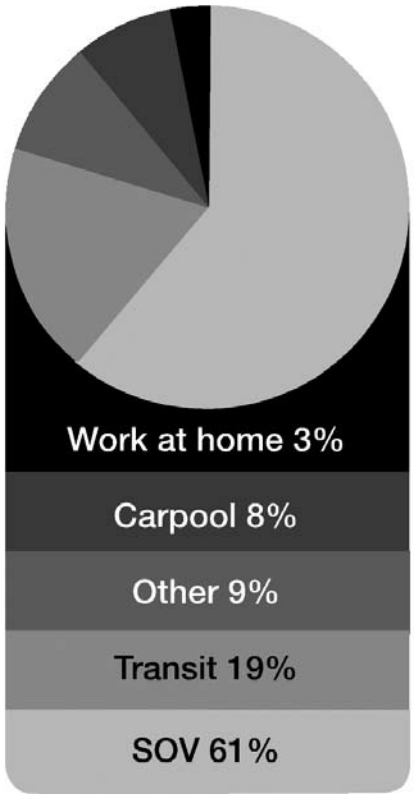


The Westwood and Forest Hills developments also envision substantial commercial activity. The completed Westwood development would include 1.25 million square feet of retail space and 1.65 million square feet of office space, and the Forest Hills project proposes 250,000 square feet of office space. These projects clearly qualify as transit-oriented developments.

Journey to Work

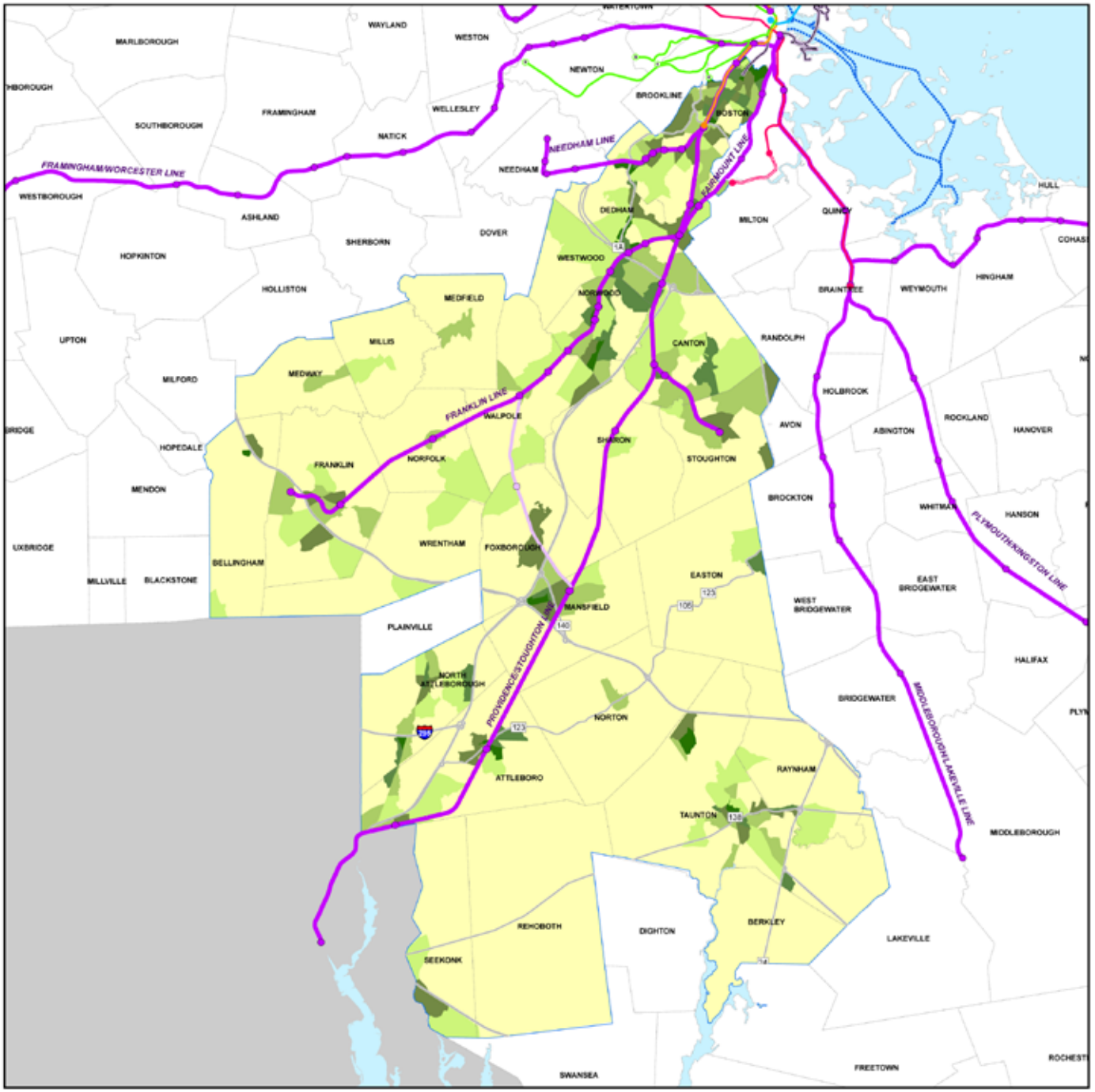
Nationally, work trips comprise a small proportion—15 %—of all trips.[3] Because most commuting occurs during peak travel times, work-trip volumes determine the capacity needs, as well as the performance, of highway and transit systems. In the year 2000, of all work trips that originated in the Southwest Corridor, 61% were made in single-occupancy vehicles (SOVs); 19% were made on transit. (See Figure E-3.) Comparable figures, excluding the areas of Boston that are in the Southwest Corridor, are 82% single-occupancy vehicle and 6% transit. (See Figure E-4.)

FIGURE E-3
2000 Travel Modes to Work by Southwest Corridor Residents



2 Ibid.

3 *Commuting in America III: The Third National Report on Commuting Patterns and Trends*, NCHRP Report 550, Transportation Research Board, October 2006, p. 3.



MAP E-3
Southwest Corridor of the MBTA Service Area

Employment Density, 2000

2000 CTPS Employment Database
Employees/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 1,000,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

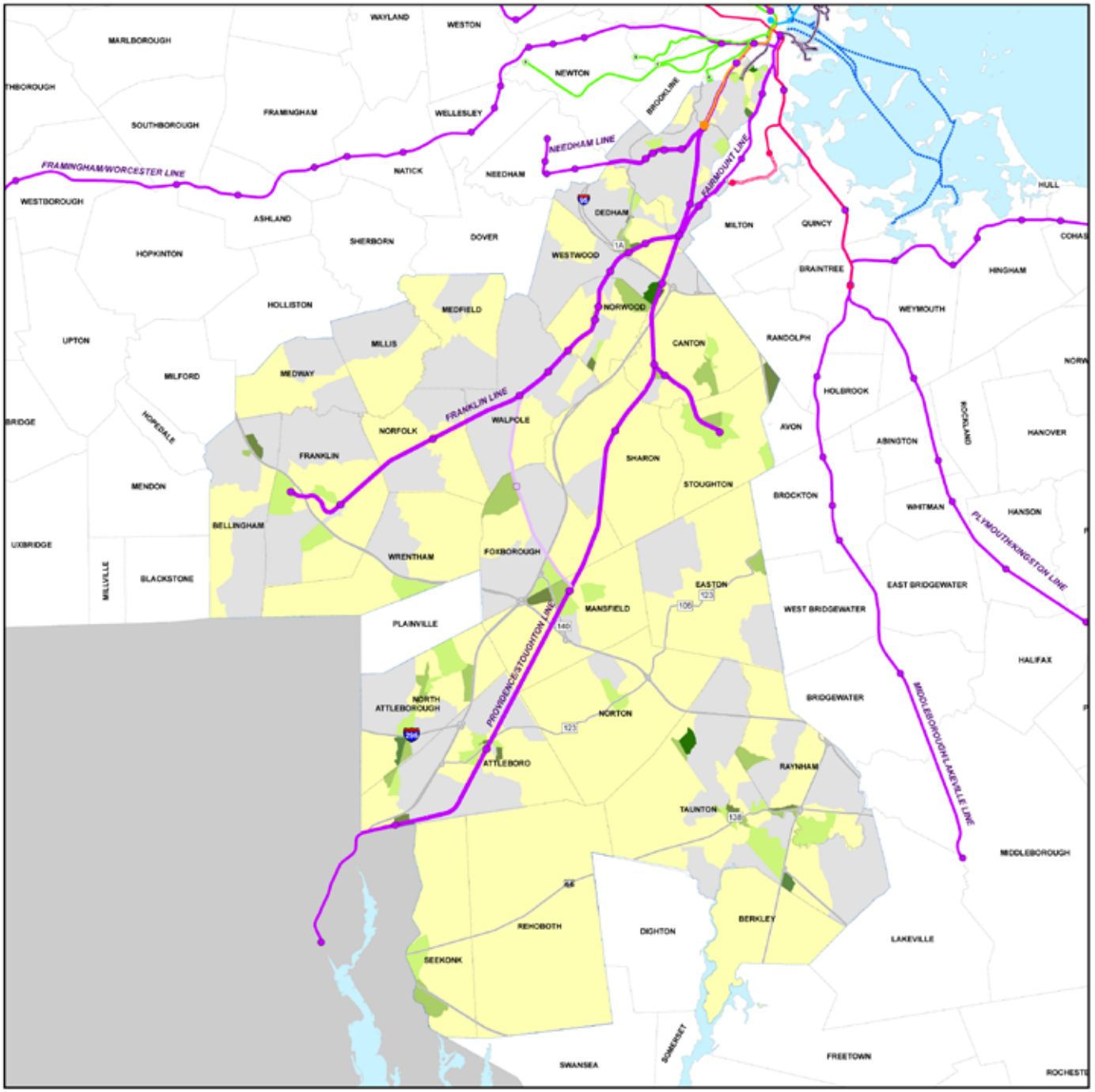
- Commuter rail line
- Special MBTA sporting events

0 1.25 2.5 5 Miles

N

MBTA Program for Mass Transportation

March 2008



MAP E-4
Southwest Corridor of the MBTA Service Area

Projected Change in Employment Density from 2000 to 2030

2030 MetroFuture Projection
Change in Employees/Sq. Mi. by TAZ

- -94,000 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 400,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Mattapan High Speed Line
- Red Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 2 4 8 Miles

N

MBTA Program for Mass Transportation

March 2008

FIGURE E-4
2000 Travel Modes to Work by Southwest Corridor Residents (Excluding Boston)

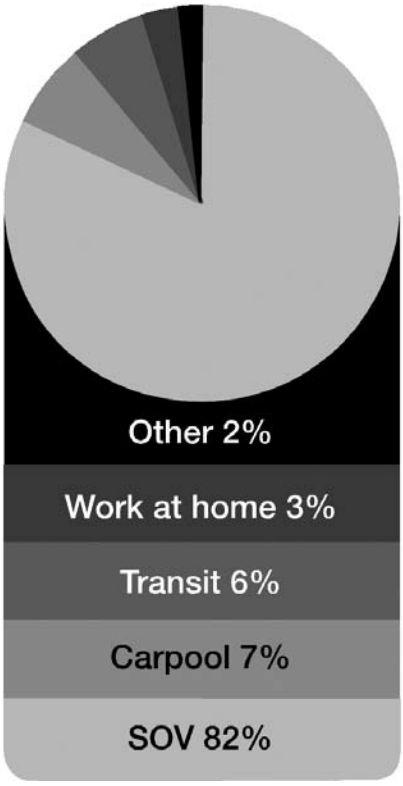
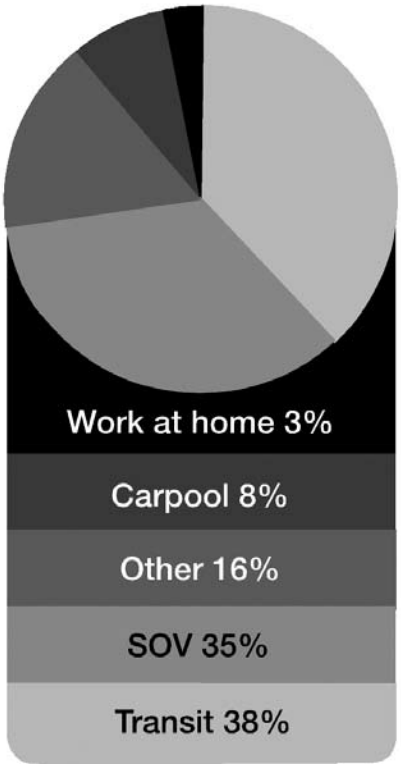
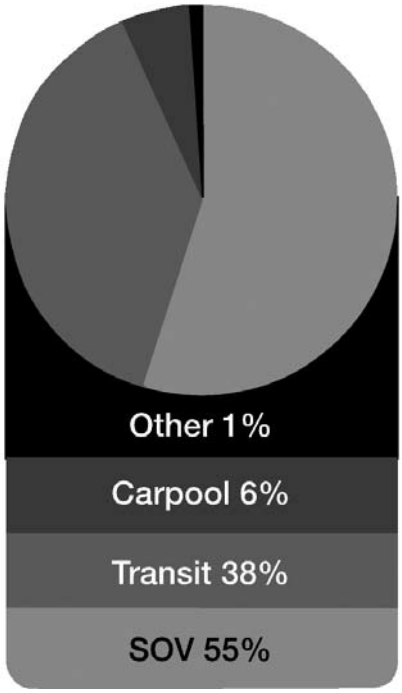


FIGURE E-5
2000 Travel Modes to Work in Boston and Cambridge by Southwest Corridor Residents



Most MBTA service is radially oriented towards Boston and Cambridge, which, together, are the destinations for 44% of the work trips made by corridor residents (Boston by itself attracts 85% of these work trips). Of the work trips made by corridor residents to Boston and Cambridge, 35% are made in single-occupancy vehicles, and 38% are transit trips. (See Figure E-5.) When work trips made by residents of the City of Boston are excluded, the proportions of corridor residents commuting to Boston and Cambridge are 55% single-occupancy vehicle and 37% transit. (See Figure E-6.)

FIGURE E-6
2000 Travel Modes to Work in Boston and Cambridge by Southwest Corridor Residents (Excluding Boston)



Traffic Congestion

There are no radial highways from this corridor directly to Boston. I-95 runs from the Rhode Island border at Attleboro to Route 128 in Canton. It then follows Route 128 to the northwest, arcing around the inner suburbs until Peabody, where it splits off from Route 128 and turns north to New Hampshire. The most direct route to Boston from I-95 in Canton is I-93, which begins at I-95 and goes east to the Braintree split. It then turns north, passes under Boston in the Tip O'Neill tunnel, and continues north to New Hampshire. South of Sharon, average speeds are 60 mph or more on I-95, with varying inbound AM peak-period speeds as low as 30–44 mph between Sharon and Route 128.

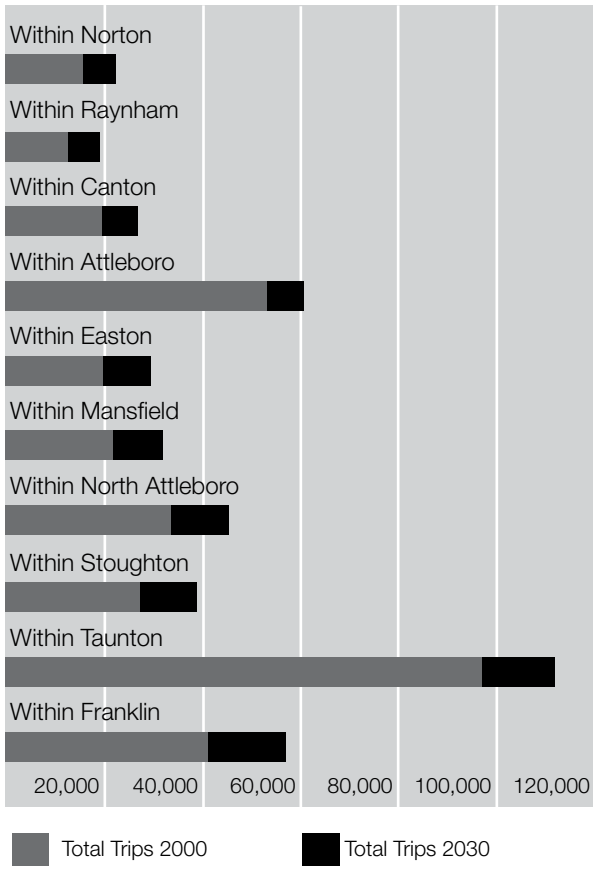
Traffic counts indicate that about 57,000 vehicles travel each way per weekday through the segment of I-95 just south of Route 128. The Providence/Stoughton commuter rail line serves the same corridor. Recent counts indicate that there are about 15,600 inbound riders per weekday on trains on this line as they leave Route 128 Station. This is equal to a 21.5% share of the combined person-volume on the trains and I-95, ignoring multiple-occupancy of highway vehicles. This unusually high share is partly attributable to the high average train speeds and service frequencies on this route, as well as to the lack of a direct highway route to the urban core north of Route 128.

Travel Projections

The CTPS regional travel-demand model provides estimates of current travel volumes and projections of future travel volumes for all major modes: auto, transit, and walk/bike. A useful way of tracking travel growth patterns is to look at the change in travel between pairs of municipalities, to include trips beginning and ending in the same municipality. By 2030, there are projected to be 46 travel pairs in the Southwest Corridor with predicted increases of at least 1,000 two-way trips per day. The projected travel-volume increase for these 46 pairs is 203,103 trips per day (approximately 28.1%).

Since some of these cities and towns have large land areas, a major portion of the additional trips are projected to take place entirely within the municipality. Of the 46 pairs with predicted travel-volume increases of over 1,000, 25 are for trips that begin and end within one municipality, notably trips made within Franklin (15,862), within Taunton (14,796), within Stoughton (11,723, within North Attleborough (11,675), and within Mansfield (10,411). In 19 instances, increases of more than 1,000 trips between adjoining municipalities or neighborhoods are projected. (See Figure E-7.)

FIGURE E-7
Southwest Corridor Trip Increases 2000-2030: Top Ten in Order of Increase



In 2000 Taunton had the highest number of existing trips in the corridor that have both ends in one municipality. Taunton has a dense central core and is served by several local bus routes of the Greater Attleboro Taunton Regional Transit Authority, but Franklin, Stoughton, North Attleborough, and Mansfield all have very limited existing

bus services, despite having achieved some central density. Many of the other projected travel-volume increases in this corridor are also between points with either limited or no transit service connections.

The model also projects that there will be 17 increases of over 1,000 daily trips between points in the Southwest Corridor and points in other PMT corridors, including 7 with the Southeast Corridor, 8 with the West Corridor, and one each with Boston Proper and the Northwest Corridor. The more compact Boston neighborhoods show the largest number of new trips spilling over into adjoining corridors, notably between the Fenway and Roxbury neighborhoods (3,113), and between the Longwood Medical and Academic Area and Roxbury (2,727). The projected increases for the other 15 pairs are all below 1,800.

Environmental Justice

The federal government defines environmental justice (EJ) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, education level, or income with respect to the development, implementation, and enforcement of environmental laws. The MBTA monitors EJ through implementation of and reporting for Title VI of the Civil Rights Act of 1964.

The Southwest Corridor encompasses several of Boston's densely populated neighborhoods: Roxbury, Jamaica Plain, Roslindale, and West Roxbury. All of Roxbury and most of Jamaica Plain and Roslindale are classified as minority areas for Title VI. Most of Roxbury and part of Roslindale are classified as both low-income and minority. Outside of Boston, only small pockets of minority or low-income areas exist in the other municipalities in the Southwest Corridor. Attleboro includes a small area that is minority but not low-income, and Taunton is home to a small area that is low-income but not minority.

Over 40 bus routes operate in the Southwest Corridor; 34 of these routes are classified as minority, and 15 are classified as both minority and low-income.

The Silver Line Washington Street bus rapid transit (BRT) line operates in the Southwest Corridor, and all of the stops in this corridor are classified as both minority and low-income.

A portion of the Orange Line operates in the Southwest Corridor. All of the Orange Line stations in this corridor are classified as minority, and three of the stations are classified as low-income as well.

Two commuter rail lines operate exclusively in this corridor. Five stations, four of which are located in Boston, meet the minority station criterion; one meets the criteria for both minority and low-income stations.

MOBILITY PROBLEMS AND PROPOSED SOLUTIONS

Capacity Improvements Are Needed

Investments Will Be Needed to Ensure that Sufficient Capacity Is Available to Serve Current and Projected Travel Demand.

Problem 1:

As indicated above, by 2030 large growth in intra-city trips is projected for Stoughton, Canton, Norwood, and Walpole. In addition to commuter rail service in these four communities, Norwood and Walpole are currently served by local bus Route 34E, Canton by Route 716, and Stoughton by BAT.

Proposed Solution:

Expand MBTA fixed-route service (or partner with local social-service providers, town officials, and the Boston Region MPO to institute a new demand-responsive service) to connect densely developed residential areas with key activity hubs (including employment, commercial, and educational hubs) along radial express-highway corridors, especially the new Westwood Station transit-oriented development. Similar efforts could also be encouraged with neighboring RTAs and MPOs for communities like Stoughton that are outside the MBTA and Boston Region MPO service areas.

Problem 2:

By 2030, modeling projections suggest that 12 bus routes in the Southwest Corridor may cause passenger-crowding levels that would trigger the need for additional service. These include:

- Bus Route 15 Kane Square – Ruggles Station
- Bus Route 19 Fields Corner Station – Ruggles Station via Grove Hall
- Bus Route 21 Ashmont Station – Forest Hills Station
- Bus Route 22 Ashmont Station – Ruggles via Jackson Square Station
- Bus Route 28 Mattapan Station – Ruggles Station via Dudley
- Bus Route 37 Baker and Vermont Streets – Forest Hills Station
- Bus Route 40 Georgetown - Forest Hills Station via Alwin Street
- Bus Route 43 Ruggles Station - Park and Tremont Streets
- Bus Route 47 Cambridge Central Square – Broadway Station
- Bus Route 66 Harvard Square – Dudley Station via Harvard Street
- Bus Route CT1 Central Square Cambridge – B.U. Medical Center/Boston Medical Center
- Bus Route CT3 Beth Israel Deaconess – Andrew Station via B.U. Medical Center

Several of these routes provide circumferential connections between the Southwest and other corridors. Route 47 also operates in the Northwest Corridor, Routes 19, 22, and 28 also operate in the Southeast Corridor, and Route 66 also operates in the Northwest and West Corridors, Route CT1 also operates in the Northwest Corridor, and CT3 also operates in the Southeast Corridor. These routes are also discussed in the corresponding problem statements.

Proposed Solutions:

- To increase peak-period capacity and to ensure that crowding does not exceed safe and comfortable levels, 22 additional 40-foot buses would be required to operate these routes. Replacing existing 40-foot buses with 60-foot buses would be another method for increasing capacity to meet demand.
- Implement bus-rapid-transit (BRT) elements, such as signal priority, cue jumps, fare pre-payment, a dedicated lane, lengthened stop spacing, improved bus stop amenities, etc.
- Extend BRT service from Dudley Square South along the Warren Street and Blue Hill Avenue corridor, which is served by Route 28.
- Implement the Urban Ring project.

Problem 3:

Some desirable destinations in the Southwest do not have direct rail service to Boston. Though it is currently beyond the boundaries of the MBTA's service area, Fall River was considered in this assessment, and it was determined that it could benefit from service extensions.

Proposed Solution:

Implement the South Coast Rail project

Problem 4:

Densely populated areas currently served by Silver Line Washington Street lack direct transit connections to jobs and travel at Logan Airport and to the jobs in downtown and the rapidly growing waterfront area. The Silver Line Waterfront service does not provide direct connections to the Green Line or Orange Line.

Proposed Solution:

- Implement Silver Line Phase III.
- Implement light rail on Washington Street to connect directly to the Green Line.

Problem 5:

Very densely populated areas in the corridor are currently served by MBTA bus Routes 23 and 28 but do not have frequent rapid transit access within a reasonable walking distance. In addition, travel times on Routes 23 and 28 are long and unreliable, and Route 23 has difficulty meeting demand since it uses 40-foot buses in mixed traffic.

Proposed Solutions:

- Extend BRT service from Dudley Square along Warren Street to Grove Hall, continuing on Blue Hill Avenue to Mattapan Station and on Washington Street to Ashmont Station.
- Implement Fairmount Line improvements including four new stations. This is a State Implementation Plan (SIP) commitment in the MBTA's Capital Investment Program (CIP). A fifth new station might also be considered.
- Extend third track from Readville to Route 128/ Canton for Fairmount Line Shuttle service.
- Extend Orange Line service from Forest Hills Station to the Route 128 Station via the Providence commuter rail line right-of-way. This extension would include three stations in Boston neighborhoods.

Problem 6:

Air-traffic capacity constraints at Logan Airport call for a regional effort to attract suburban trips to other airports.

Proposed Solution:

Extend Commuter Rail from Providence to T. F. Green Airport. This project would be funded by Rhode Island.

Problem 7:

Bus Route 39 is the most heavily used route in a busy corridor.

Proposed Solution:

Implement BRT in this corridor.

Problem 8:

Many of the commuter rail trains that pass through Ruggles Station cannot stop due to platform capacity constraints.

Proposed Solution:

Build a new northbound platform at Ruggles Station.

Problem 9:

Transit Access to Milford is limited (only a few MetroWest RTA trips in the peaks), and Milford serves as a regional employment center.

Proposed Solution:

Extend Franklin Line service along the existing freight line to Milford.

Problem 10:

The new economic development projects at Foxboro Stadium warrant consideration of regular commuter rail service.

Proposed Solution:

Expand the Foxborough service to include weekday service for commuters.

Problem 11:

The capacity of the Franklin Line is constrained by single track near Readville.

Proposed Solution:

Increase capacity of existing Franklin Line service by double-tracking the existing line near Readville.

Problem 12:

Some single-track sections limit service capacity on the Stoughton and Needham Lines.

Proposed Solution:

Double-track between Canton Center and Stoughton and between the Plains Interlocking and Needham.

Access to MBTA Services Needs to Be Improved

ADA Accessibility

Problem:

Although the MBTA has made strides toward providing ADA accessibility to all of its services,

some gaps still remain. On the Providence/ Stoughton Line, accessibility improvements are currently planned for Sharon Station; and on the Franklin Line, Franklin, Walpole, Plimptonville, Windsor Gardens, Islington, and Endicott stations have not yet been made accessible.

Proposed Solution:

Based on the feasibility of construction, the following stations (Table E-1) are a priority for near-term accessibility improvements.

TABLE E-1
Southwest Corridor
Station Accessibility Priorities

Line	Station	Priority
Franklin	Franklin/Dean College	High
	Walpole	Medium
	Windsor Gardens	Medium
	Endicott	Low

Station Parking

Problem 1:

Access to rail transit services, for customers of all abilities, is constrained by the availability of parking for automobiles. Currently, parking is at or near capacity at a number of commuter rail and rapid transit stations in the Southwest Corridor.

An inventory of station parking that was completed during the fall of 2005 and winter of 2006 (Table E-2) shows that parking at the following stations is utilized at 85% of capacity or greater.[4]

TABLE E-2
Southwest Corridor
Station Parking at 85% Usage or Greater

Line	Station
Needham Line	Hersey
	West Roxbury
	Highland
	Bellevue
Franklin Line	Forge Park
	Franklin
	Norfolk
	Endicott
Providence/Stoughton Line	Attleboro
	Mansfield[5]
	Sharon
	Stoughton
	Canton Center
	Canton Junction
	Hyde Park
Orange Line	Forest Hills
	Green Street

Proposed Solution:

At stations where the MBTA is the principal provider of parking, the MBTA can address inadequate parking capacity either by increasing the number of spaces or by controlling demand through measures like raising the price of parking overall or installing automated parking-fee collection at MBTA lots to allow for congestion pricing and to improve enforcement of parking regulations.

When evaluating expansion of parking, important considerations include the availability of MBTA-owned land, the potential cost of acquiring nearby land, and the potential cost of a multilevel structure. Based on these and other feasibility criteria, all of the stations in the table above would have some potential for expansion of MBTA parking: Forge Park, Franklin, and Norfolk on the Franklin

4 Fijalkowski, Jared, and Ostertog, Heather, *Inventory of Park-and-Ride Lots at MBTA Facilities*, Central Transportation Planning Staff, February 27, 2007.

5 Restoring the Foxborough spur to full service would relieve pressure on Mansfield, where the system is parking constrained, and would provide access to Patriot Place, a regionally significant development.

Line; Attleboro, Mansfield, Sharon, Stoughton, and Canton on the Providence/Stoughton Line; and Forest Hills on the Orange Line.

Problem 2:

For some customers, access to rail services is constrained by the lack of bicycle parking. A recent study provided a detailed inventory of bicycle amenities, by MBTA station, that included the location, number, and condition of bike racks, bike rack shelters, and signage directing cyclists to them. The study also noted that, at some stations where bike racks were provided, cyclists did not utilize the racks, but parked their bikes elsewhere.[6]

Proposed Solution:

The study recommended that the MBTA continue to expand bicycle parking at stations; however, the MBTA does not currently have a standard for determining what the appropriate number of spaces would be for each station. The study therefore also recommended that the MBTA adopt a standard for providing bicycle parking spaces at transit stations.

In instances where bikes were parked at locations other than at bike racks that were provided, the study made recommendations, based on the type of problem observed, including:

- The rack was in an inconvenient location (e.g., far from the platform).
- The rack was not sheltered from the weather.
- The rack was in a secluded location that was difficult to find or might encourage theft.
- The rack was damaged or difficult to use.

The following specific improvements recommended for stations at which existing bike racks were not used.[7] (See Table E-3.)

TABLE E-3
Southwest Corridor
Bicycle Parking Improvements

Line	Station	Recommendation
Orange Line	Ruggles	Provide shelter for existing racks.
	Green Street	Provide shelter for existing racks.
	Needham Center	Provide shelter for existing racks.
Needham Line	Highland	Install racks.
	Hersey	Relocate racks to top of staircase.
Franklin Line	Dedham Corp. Center	Install racks.
	Norfolk	Provide shelter for existing racks.
Providence/ Stoughton Line	South Attleborough	Provide shelter for existing racks.
	Canton Junction	Relocate existing racks to under the shelter.

Connections With Other RTAs

Problem:

Two Regional Transit Authorities (RTAs) that provide connections to MBTA services serve the Southwest Corridor. Although it is possible to transfer between these RTAs and MBTA commuter rail stations, in many cases the present schedules do not provide convenient connections.

In downtown Attleboro, the endpoint of all the GATRA routes is a bus shelter on Union Street south of Park Street, only about one-tenth of a mile from Attleboro Station. Three routes also pass directly by Attleboro Station, but the others do not. Only two GATRA routes serve South Attleborough Station directly. Four routes have hourly service; one route has service every two hours; and three run on irregular headways ranging up to two hours or longer.

6 Fijalkowski, Jared, and Yaitanes, Justin, *2005–2006 Inventory of Bicycle Parking Spaces and Number of Parked Bicycles at MBTA Stations*, Central Transportation Planning Staff, October 2, 2007, Table 6.

7 Ibid.

The one GATRA route serving Mansfield Station originates at Wheaton College, in the town of Norton, and serves other points along state Route 140 in that town, including a park-and-ride lot. Unlike many of the other RTA services, this route was implemented primarily to provide connections to and from trains, rather than for local transportation. This route has daily service, with reduced weekend schedules. Sunday service is provided only when the college is in session.

The one Brockton Area Transit (BAT) bus route (Route 14) serving Stoughton runs between Cobbs Corner, on the border of Stoughton and Canton, to the Westgate Mall in Brockton. At the latter location, it connects with two BAT routes (4 and 4A) to the BAT Intermodal Transportation Centre in downtown Brockton. Some Route 14 trips are through-routed via the mall to the Transportation Centre. Route 14 passes within a few hundred feet of the Stoughton commuter rail station at Stoughton Square. Published Route 14 schedules do not show bus times at Stoughton Square, and do not mention the existence of the station.

Route 14 runs on an irregular headway, with intervals between trips ranging from 40 to 90 minutes. Based on the departure times shown at the ends of the route, the closest connection from an inbound Route 14 bus to an inbound AM peak-period train would require a wait of about 18 minutes at Stoughton Station. The one outbound PM peak-period trip on Route 14 would pass Stoughton Station about 35 minutes after the arrival of one train and 5 minutes before the next one.

BAT Route 14 also nominally connects at Cobbs Corner with a private-carrier bus route to Mattapan Station, funded by the MBTA as Route 716. However, most connections would require waits of 20 minutes or longer at the transfer point. Route 14 does make fairly close connections with BAT Routes 4 and 4A at Westgate Mall. Changes in the schedule of Route 14 to provide close connections with trains at Stoughton Station could result in less convenient service for passengers traveling between points on Route 14 and points on the other BAT routes.

The route operated by the Medway Council on Aging is also intended primarily to provide commuter rail connections. It runs only on weekdays. A schedule that appeared on the town's website in November 2007 showed buses scheduled to arrive at Norfolk Station 10 minutes before departures of three of the five inbound AM peak-period trains, and 11 minutes before the departure of another train. Connections from three of the five outbound PM peak-period bus trips stopping at Norfolk were also advertised, with buses apparently leaving the station as soon as transferring passengers were all on board. In Medway, buses stopped at four locations, including three with parking available for commuters.

Proposed Solution:

Although the Southwest Corridor is served by GATRA and BAT, current schedules provide few close connections between RTA and MBTA services. In general, RTA bus routes do not function well as commuter rail feeders, as they serve different functions and populations. Most RTA routes provide local service on even headways, while commuter rail provides long-distance commuter service and operates on uneven headways due to a number of equipment and operational constraints. In addition, because RTA routes have frequent stops and many do not provide direct service to stations, using them to access stations is much slower than driving.

Adjusting the RTA services to meet the commuter rail schedules would inconvenience customers making local trips. Changing the commuter rail schedules to coordinate with RTA services would require significant capital and operating costs without significantly improving service for most commuter rail riders. The best solution, therefore, would be to create RTA feeder services to commuter rail. It is recommended that the MBTA work with GATRA and BAT to select one or more stations on the Providence/Stoughton Line and to determine the number and alignment of routes that would be required to provide adequate feeder services.

The City of Attleboro is planning a major downtown revitalization project that is expected to include construction of an intermodal transportation center at Attleboro Station. This would facilitate coordination of bus and train service there.

The 2003 PMT evaluated and recommended two commuter rail feeder routes to commuter rail stations in this corridor that do not currently have bus connections. One would operate from Foxborough to Sharon on the Providence/Stoughton Line, and the other from Medway via Millis to Norfolk Station on the Franklin Line. The Medway Council on Aging route to Norfolk Station now provides some of the service that the latter recommended route would have provided.

Reverse-Commute Service

Problem:

In the Southwest Corridor, there is some potential for reverse-commute service between residential areas of Boston and employment destinations in Dedham, Norwood, and Westwood on the Franklin Line, and to Westwood and Canton on the Providence/Stoughton Line. Of these municipalities, Dedham, Norwood, and Canton are among the top 10 in the region for attracting employees from Boston neighborhoods.[8] To attract sufficient riders to justify reverse-commute services on either line, bus or van connections from stations to employment sites in the corridor, particularly along Route 128, would need to be provided.

Proposed Solution:

- The MBTA should work with area Transportation Management Associations (TMAs) to provide shuttle service to commuter rail.
- Expand reverse commute options by adding outbound AM-peak-period and inbound PM-peak-period commuter rail trips

Infrastructure Enhancements Are Needed

Problem:

In order to continue to maintain and improve service quality as demand grows and as technologies and materials improve, the MBTA will need to continually invest in infrastructure enhancements.

Proposed Solution:

Some of the infrastructure enhancement projects that have been identified as future needs are shown in Table E-4.

8 Humphrey, Thomas J., *MBTA Reverse Commuting Study*, Central Transportation Planning Staff, May, 2001, pp. ES-2 and ES-5.

TABLE E-4
Southwest Corridor
Infrastructure Enhancement Projects

BUS RAPID TRANSIT	
Asset Category	**Project Description**
Revenue vehicles	Purchase additional vehicles to support Silver Line Phase III service.
COMMUTER RAIL	
Asset Category	**Project Description**
Communications	Extend the Real Time Active Train Summary at the current commuter rail operations control center to include trains on line segments dispatched by Pan Am and Amtrak. This would minimize signaling and scheduling conflicts between MBTA commuter rail trains and freight trains by bringing all commuter rail and freight service under one system.
Maintenance facilities	Expand the Readville facility.
Maintenance facilities	Construct additional midday storage for commuter rail trains used in south-side operations.
Track/right-of-way	Add third track between Canton Junction Interlocking and Readville on the Providence Line to minimize conflicts with Acela service.
Track/right-of-way	Add third track from Mansfield to Attleboro on the Providence Line.
Track/right-of-way	Add fourth track from Readville to Forest Hills on the Providence Line
Track/right-of-way	Restore double track connection between the Fairmount and Providence Lines.

A State of Good Repair Needs to Be Achieved

Problem:

A number of system preservation projects must be addressed in the short- to mid-term to bring the system into a state of good repair and to ensure the safety of passengers and reliability of service.

Proposed Solutions:

Some of the specific projects needed to bring the system into a state of good repair and maintain it in that condition are included in Table E-5.

TABLE E-5
Southwest Corridor
State-of-Good-Repair Projects

BUS RAPID TRANSIT	
Asset Category	**Project Description**
Revenue vehicles	Complete midlife overhaul for the 17-vehicle CNG fleet currently operating on Silver Line Washington Street.
ORANGE LINE	
Asset Category	**Project Description**
Power	Remove all manhole cable switches from the manholes on the Orange Line between Massachusetts Avenue and Forest Hills stations and replace with new cable switches.
Power	Install negative return cables from substations to track along the Orange Line.
Power	Install AC cable and DC breakers along the Orange Line.
Power	Upgrade the DC negative return system on the Orange Line.
Revenue vehicles	Procure new cars to allow the retirement of the Orange Line No. 12 fleet, which was purchased in 1979–1981.
Track/right-of-way	Replace concrete support pedestals that support the third rail on the Orange Line with 4,000 new blocks of treated wood. Replace approximately 2,000 feet of third rail in Orange Line station areas.
COMMUTER RAIL	
Asset Category	**Project Description**
Bridges	Replace/rehabilitate three bridges on the Fairmount Line and two on the Providence/Stoughton Line that are rated structurally deficient.

Appendix F Southeast Corridor: Mobility Problems and Proposed Solutions

BACKGROUND

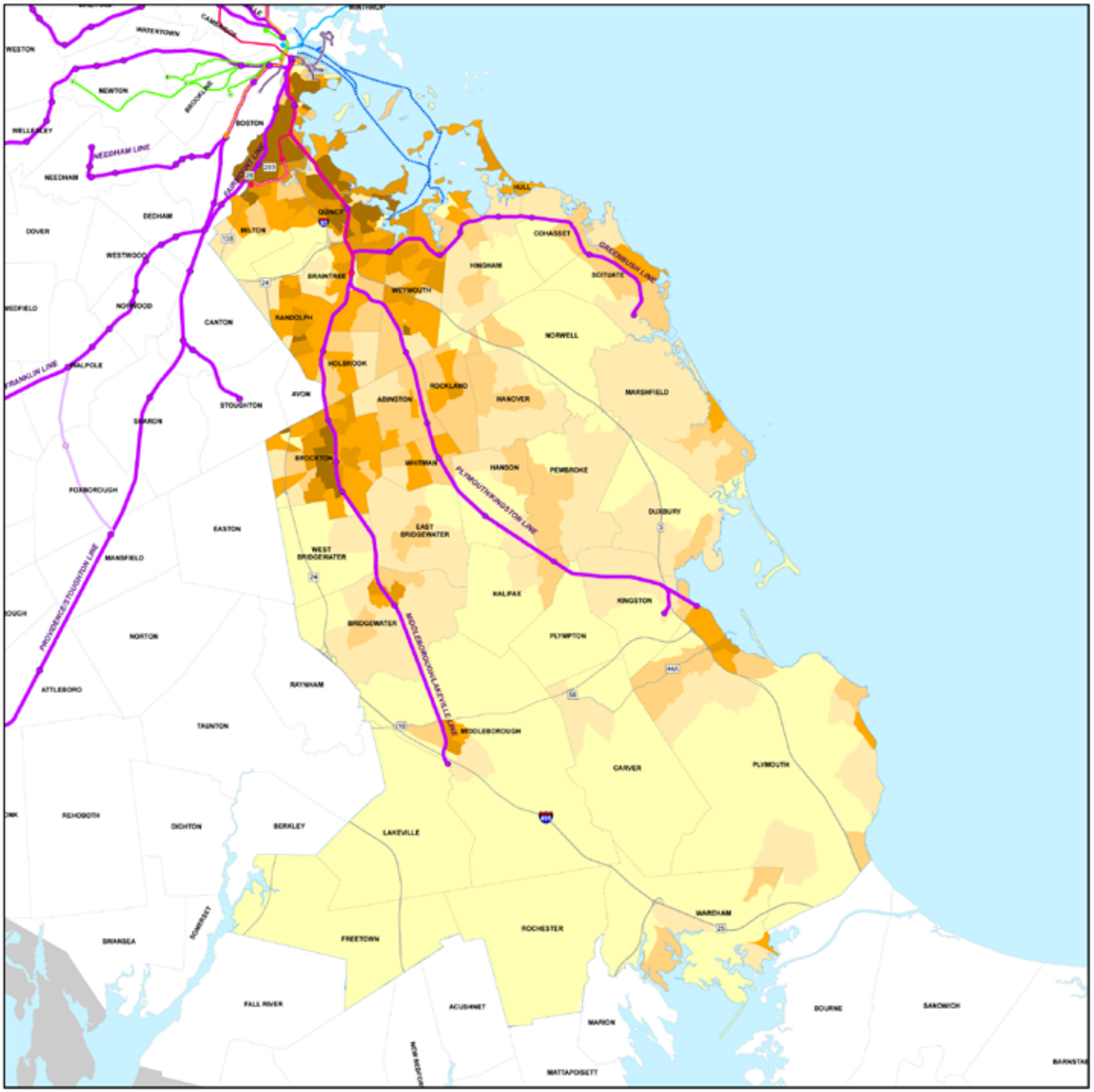
Existing Conditions

The Southeast Corridor consists of the Boston neighborhoods of South Boston, Dorchester, and Mattapan, the cities of Quincy and Brockton, and 31 towns stretching from Milton to the Taunton River and Buzzard's Bay. These communities range from dense urban neighborhoods, to older industrial cities, to agricultural towns dating back to the Plymouth Colony (later referred to as the "Old Colony"), as well as a very diverse assortment of suburban communities.

The most extensive MBTA rapid transit services are offered in this corridor. The Boston neighborhoods, city of Quincy, and towns of Milton and Braintree have MBTA rapid transit service provided by the Braintree and Ashmont branches of the Red Line, as well as the Mattapan High Speed Line.

There is also an expanding set of commuter rail services in the Southeast Corridor. Those parts of Dorchester and Mattapan not near the Red Line have some commuter rail service provided by the Fairmount Line, which is currently being upgraded. Southeast of Quincy and Braintree, the Middleborough/Lakeville and Plymouth/Kingston Lines, as well as the recently completed Greenbush Line, provide commuter rail service and lie entirely within the Southeast Corridor. The MBTA also operates 15 local bus routes and provides commuter boat service to Quincy, Hingham, and Hull.

In addition to the MBTA, the Brockton Area Transit Authority (BAT) also provides public transportation services in the Southeast Corridor, operating 11 bus routes, one of which connects with the Red Line at Ashmont. The Plymouth & Brockton Street Railway Company and JBL Bus Lines operate private-carrier bus service in the corridor as well.



MAP F-1
Southeast Corridor of the MBTA Service Area

Population Density, 2000

U. S. Census 2000
Population/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 176,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

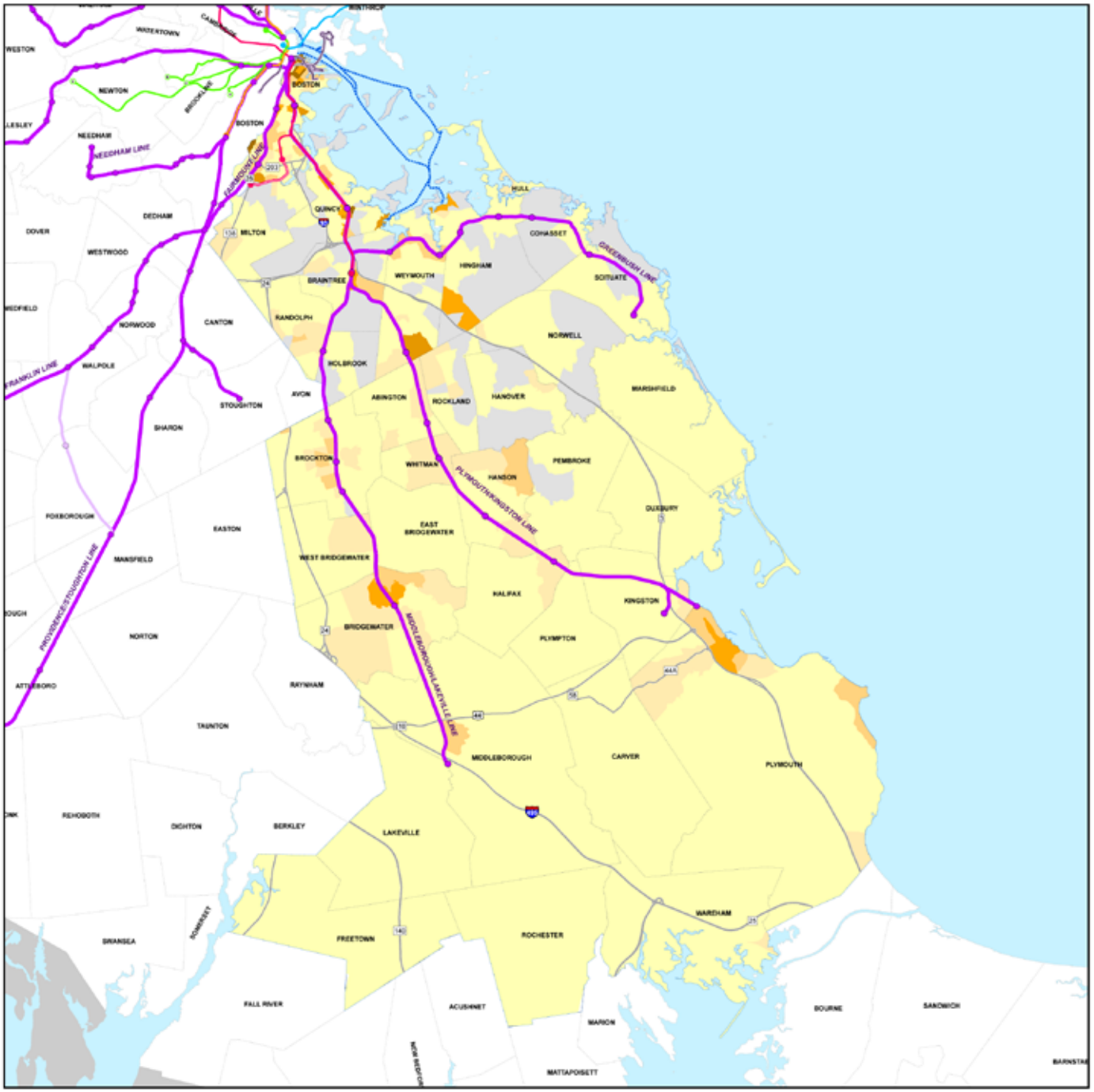
- Commuter rail line

0 2.5 5 10 Miles

N

MBTA Program for Mass Transportation

March 2008



MAP F-2
Southeast Corridor of the MBTA Service Area

Projected Change in Population Density from 2000 to 2030

2030 MetroFuture Projection
Change in Population/Sq. Mi. by TAZ

- -4,086 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 164,061

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 2 4 8 Miles

MBTA Program for Mass Transportation

March 2008

N

Population

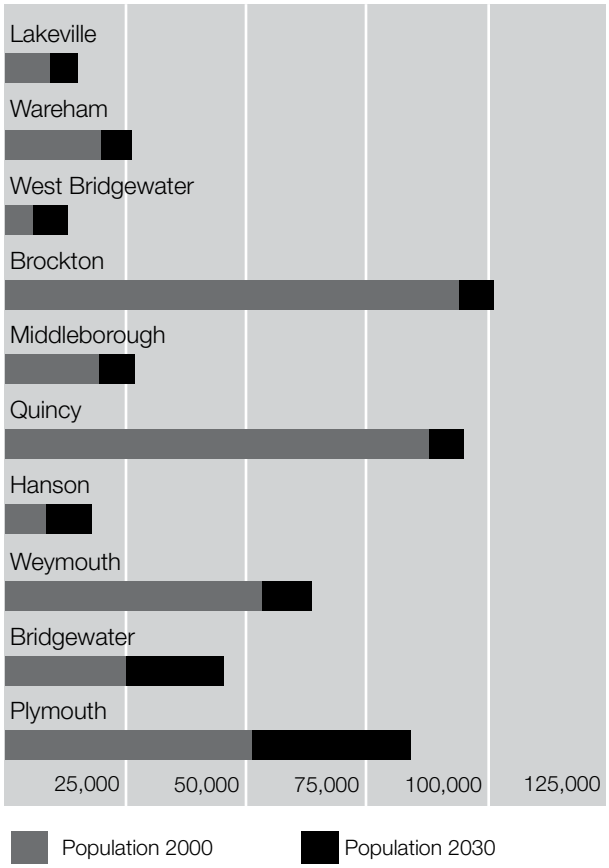
The Southeast Corridor is most densely populated in the Boston neighborhoods and the two cities. Milton, Randolph, Braintree, and Weymouth are reasonably dense, but town density tends to decline as one moves further from Boston (see Map F-1). Areas of several communities in the northern part of the corridor are projected to experience decreasing population densities between 2000 and 2030, but densities in most communities are projected to remain stable or to increase moderately (see Map F-2).

According to the U.S. Census, the year 2000 population in the corridor was 721,366, or 11% of the state population. Population is projected to grow by 24% to 895,363 people by 2030.[1] Approximately two-thirds of the corridor communities will experience double-digit growth during this period, while population in two communities, Plympton and West Bridgewater, will more than double. In terms of absolute numbers, almost one-third of total growth will occur in Plymouth and Bridgewater, both of which have commuter rail stations (see Figure F-1).

A proposed large residential development project in Plymouth, called Pinehills, embracing "New Urbanism," is projected to consist of over 3,000 homes, four golf courses, and a village center. Also planned are 675 homes at Cordage Park, adjacent to Plymouth Station, a classic transit-oriented development.

The largest housing and employment growth impact in this corridor is the redevelopment of the South Weymouth Naval Air Station, portions of which are in Weymouth, Rockland, and Abington. This extensive development is near the South Weymouth commuter rail station and will include 2,855 housing units.

FIGURE F-1
Southeast Corridor 2000-2030
Population Growth: Top Ten Communities in Order of Increase



Employment

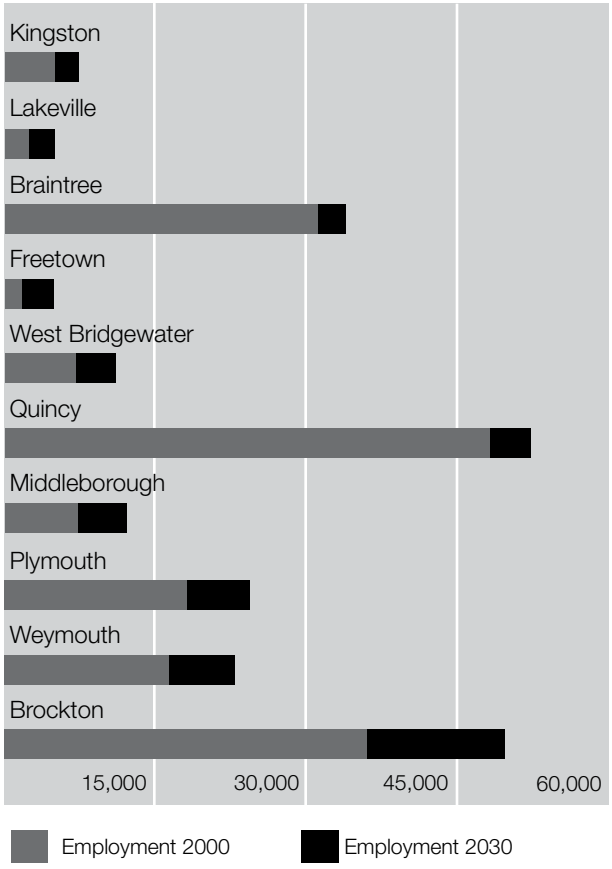
The southernmost communities, with the exception of a few small pockets, have very low employment densities. The northernmost communities generally have the highest employment densities, particularly those closest to Boston and portions of Brockton, as well as those along Route 3, including Weymouth, Hingham, and Norwell. (See Map F-3.) Projections indicate little or no change in employment densities for the majority of the corridor between 2000 and 2030 (see Map F-4).

Employment in the corridor is projected to increase by 25% between 2000 and 2030. Most

1 Metropolitan Area Planning Council (MAPC), Old Colony Planning Council (OCPC), and Southeastern Regional Planning and Economic Development District (SRPEDD) population and employment forecasts.

communities will experience modest growth in absolute terms.[2] Almost half (46%) of the corridor's employment growth will occur in four communities: Brockton (20%), Weymouth (10%), Plymouth (9%), and Middleborough (7%). Although Quincy will continue to have the corridor's highest employment, its growth will be modest (see Figure F-2).

FIGURE F-2
Southeast Corridor 2000-2030
Employment Growth: Top Ten Communities in Order of Increase

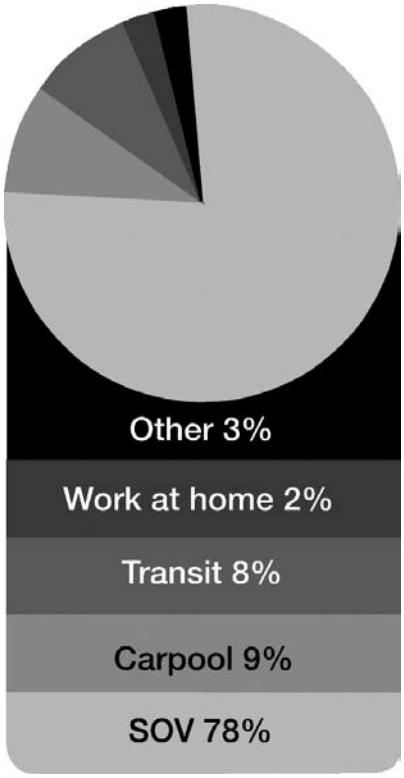


The largest new employment site that is planned in this corridor is redevelopment of the 1,400-acre South Weymouth Naval Air Station, which, in addition to the substantial housing component discussed above, envisions 2 million square feet of commercial development, including the Southfield Science Center for biotech companies. A large transit-oriented development planned for the corridor is Cordage Park, in Plymouth, with 50,000 square feet of retail and 600,000 square feet of office space planned to be in close proximity to commuter rail. Another potential employment generator in the corridor could be the casino in Middleborough that is currently under consideration, and the upgrading of U.S. 44 to a limited-access highway in Plymouth will also facilitate employment growth.

Journey to Work

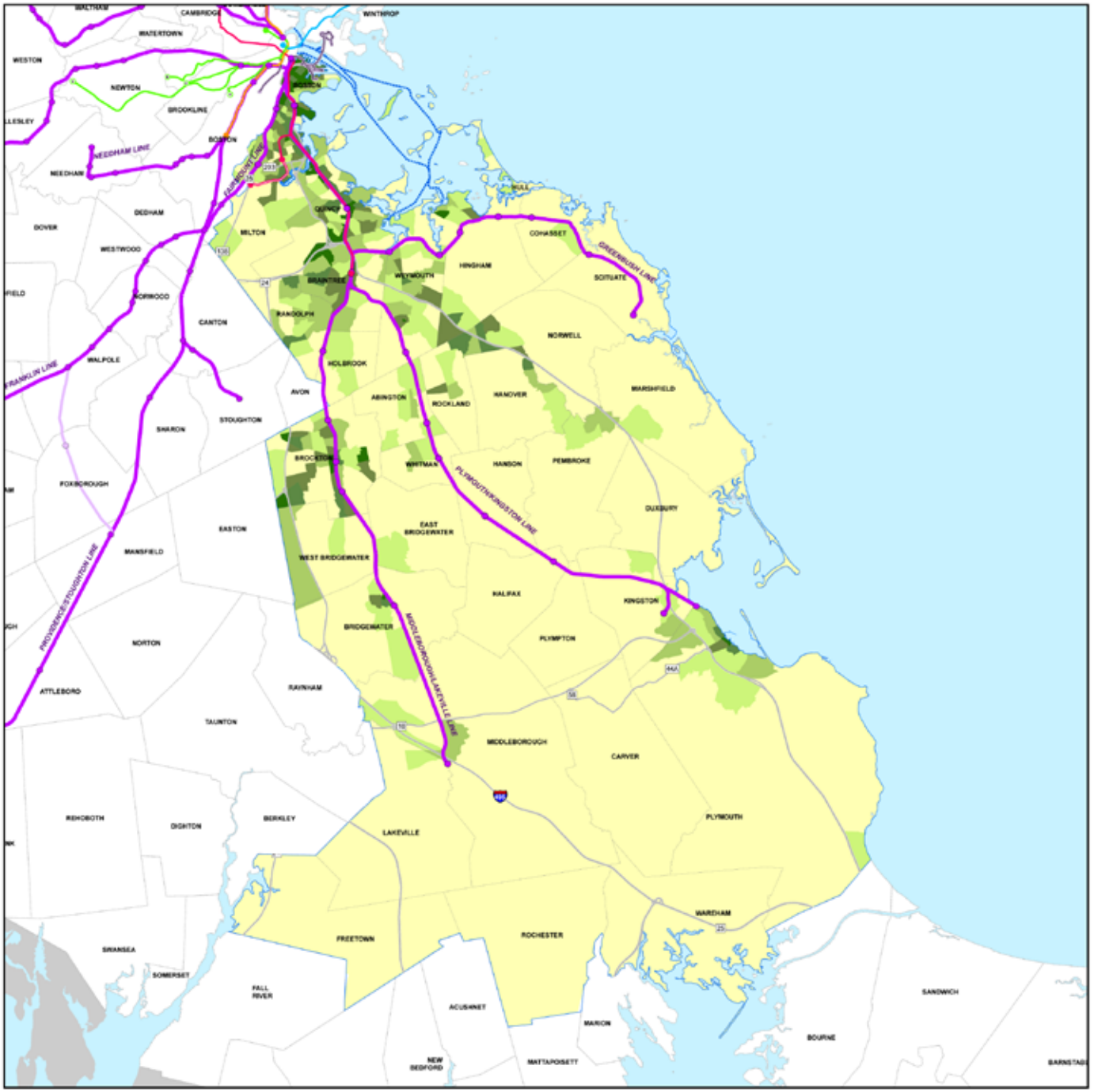
Nationally, work trips account for a small proportion—15%—of all trips.[3] Because most commuting occurs during peak travel times, work-trip volumes determine the capacity needs, as well as the performance, of highway and transit systems. Of all work trips that originate in the Southeast Corridor, 78% were made in single-occupancy vehicles (SOVs) in 2000; 8% were made by transit (see Figure F-3).

FIGURE F-3
2000 Travel Modes to Work by Southeast Corridor Residents



2 Ibid.

3 Transportation Research Board, *Commuting in America III: The Third National Report on Commuting Patterns and Trends*, NCHRP Report 550, October 2006, p. 3.



MAP F-3
Southeast Corridor of the MBTA Service Area

Employment Density, 2000

2000 CTPS Employment Database
Employees/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 1,000,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

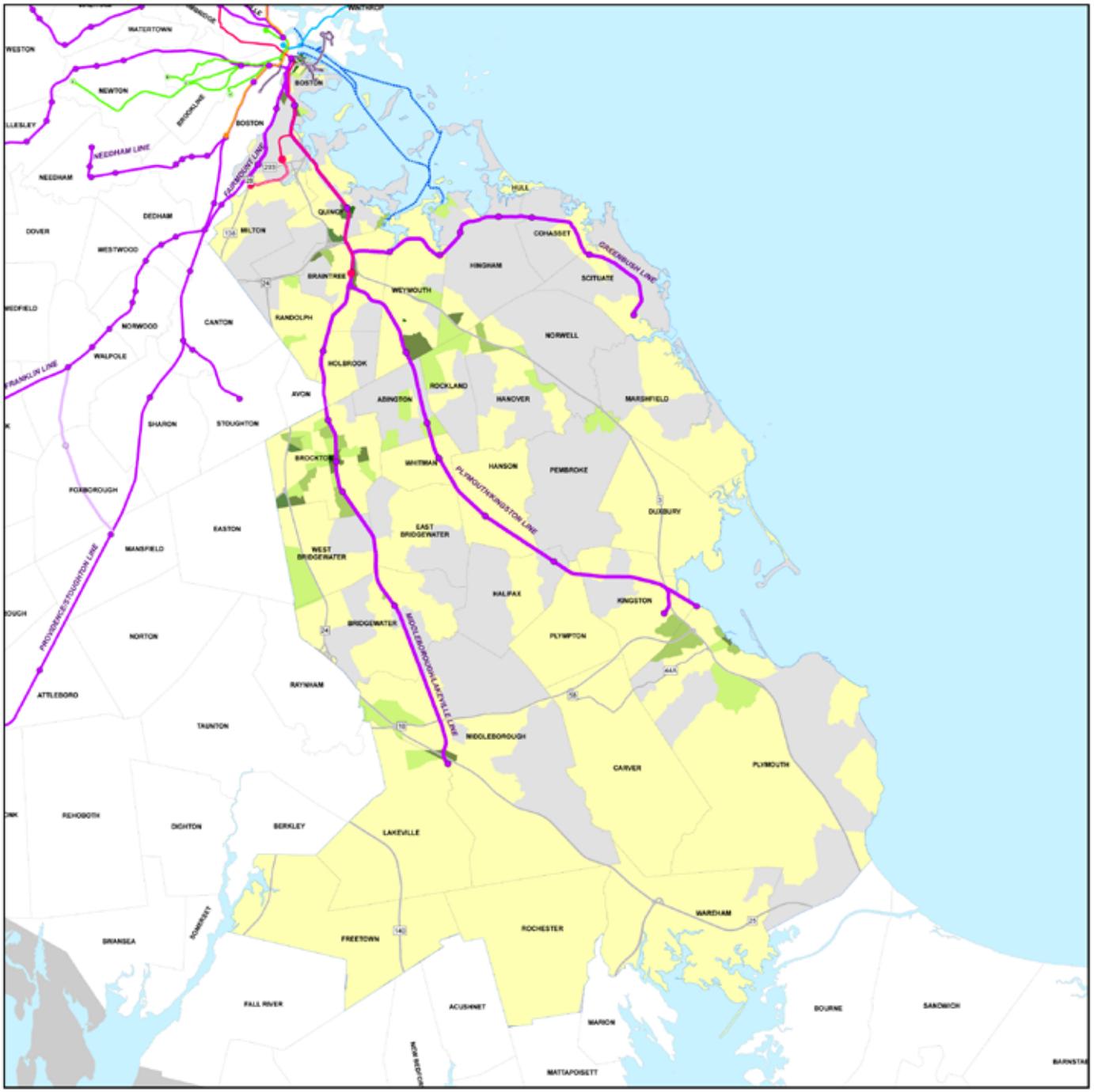
- Commuter rail line
- Special MBTA sporting events

0 1.5 3 6 Miles

MBTA Program for Mass Transportation

March 2008

N



MAP F-4
Southeast Corridor of the MBTA Service Area

Projected Change in Employment Density from 2000 to 2030

2030 MetroFuture Projection
Change in Employees/Sq. Mi. by TAZ

- -94,000 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 400,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Mattapan High Speed Line
- Red Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 2.5 5 10 Miles

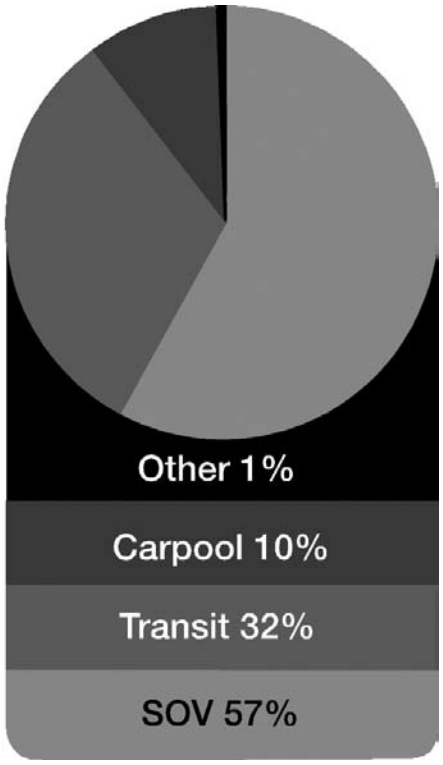
N

MBTA Program for Mass Transportation

March 2008

Only 20% of the work trips from the Southeast Corridor are destined for Boston or Cambridge. However, because of the strong radial MBTA service offerings, 32% of these work trips are by transit (see Figure F-4).

FIGURE F-4
2000 Travel Modes to Work by Southeast Corridor Residents to Boston and Cambridge



Traffic Congestion

Congestion appears to be a factor in the number of Boston commuters using transit in the Southeast Corridor. The entire radial highway system in this corridor connects to the Southeast Expressway, which is designated I-93 and MA Route 3. From the Braintree split, Route 3 continues to the southeast to the Sagamore Bridge over the Cape Cod Canal. The other branch of the Braintree split, which is a continuation of I-93 southbound, leads to MA Route 24, which goes south to Fall River, New Bedford, and, via I-495, to the Bourne Bridge to Cape Cod.

The Southeast Expressway is the most heavily traveled highway into Boston in the region, as it collects traffic coming from the south on Routes 3 and 24, and I-95. Average northbound traffic speeds during the AM peak period are less than 30 mph for most of the length of the Southeast Expressway.[4] The ultimate bottleneck is at Savin Hill, where "zipper line" HOV traffic is forced to merge with general traffic. Two miles north, congestion eases as traffic reaches the reconstructed Central Artery.

Route 24 runs from Fall River to Route 128 in Randolph, and is the main connecting link to Boston from a number of other South Coast highways. I-93 is the most direct route to Boston from Route 24 in Randolph. Average speeds are 60 mph or more on Route 24 south of Stoughton, dropping to 30–44 mph inbound from there to Route 128 in the AM peak period.

Traffic counts indicate that about 68,000 vehicles each way per weekday travel through the segment of Route 24 just south of Route 128. The Middleborough/Lakeville commuter rail line serves the same corridor. Recent passenger counts indicate that there are about 5,100 inbound riders a day on trains on this line as they leave the Holbrook/Randolph Station. This is equal to a 7% share of the combined person-volume on the trains and Route 24, ignoring multiple occupancy of highway vehicles.

The low average speeds on the Southeast Expressway and the availability of transit service via both commuter rail and rapid transit in the corridor contribute to a high transit share for Boston-bound commuters. Where I-93 northbound and Route 3 northbound merge at Braintree, there are about 108,000 vehicle-trips each way per weekday. Recent passenger counts on the Middleborough/Lakeville and Plymouth/Kingston commuter rail lines and on the Braintree Branch of the Red Line show a combined total of about 34,500 rail passengers at the border of Quincy and Boston. This is equal to a 24% share of the combined

4 2004 Congestion Management System (CMS) Report, Central Transportation Planning Staff, December 2004.

person-volume on the trains and the Expressway (ignoring multiple occupancy of highway vehicles). The Red Line carries about 71% of the Boston-bound transit riders as it enters Boston.

Travel Projections

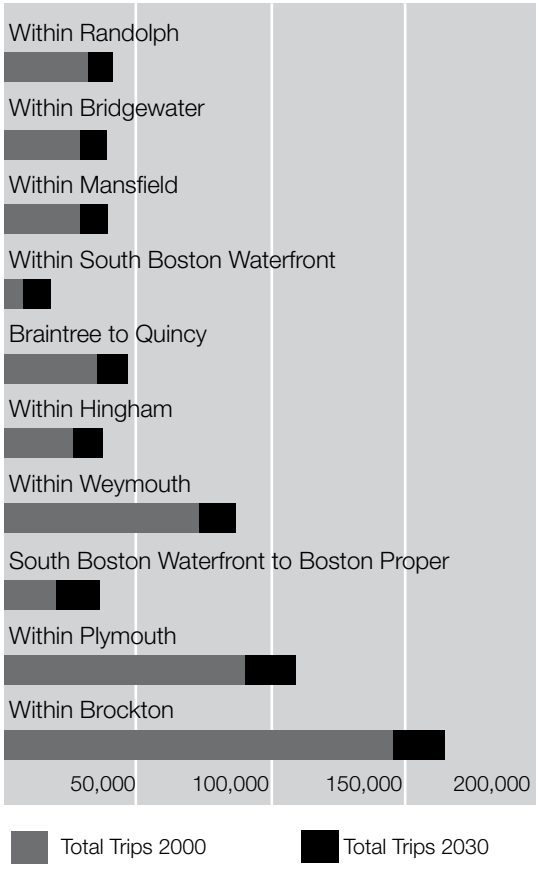
The CTPS regional travel-demand model provides estimates of current travel volumes and projections of future travel volumes for all major modes: auto, transit, and walk/bike.

A useful way of tracking travel growth patterns is to look at the change in travel between pairs of municipalities, to include trips beginning and ending in the same municipality. By 2030, there are 67 travel pairs in the Southeast Corridor with projected increases of at least 1,000 two-way trips per day. The projected travel-volume increase for these 67 pairs is 275,677 trips per day (approximately 22%).

Of the 67 pairs with predicted travel volume increases of over 1,000, 30 are for trips that begin and end within one municipality or neighborhood. These account for 69.5% of the total of all projected trip increases of over 1,000 within the corridor. Another 31 increases, accounting for 27.3% of the group total, are between adjoining municipalities or neighborhoods. Interestingly, the largest increases in the corridor are for trips within Brockton (19,509), within Plymouth (18,661), within the South Boston Waterfront area (10,065), within Weymouth (13,320), within Hingham (11,406), and between Quincy and Braintree (11,136). (See Figure F-5.)

The South Boston Waterfront is served by the Silver Line, and Quincy and Braintree are served by the Red Line. Of the communities outside of Boston, only four—Quincy, Braintree, Weymouth, and Hingham—have MBTA local bus service, although the coverage is limited in the latter three. Brockton currently has an extensive bus network operated by Brockton Area Transit. Plymouth is served by the Greater Attleboro Taunton Regional Transit Authority's Plymouth Area Link (PAL) bus network.

FIGURE F-5
Southeast Corridor Trip Increases 2000-2030: Top Ten in Order of Increase



The model also projects nine travel pairs with increases of over 1,000 daily trips between points in the Southeast Corridor and points in other PMT corridors, including seven with the Southwest Corridor and one each with Boston Proper and the Northwest Corridor. The largest of these are trips between Boston Proper and the South Boston Waterfront (15,870), with trips between Cambridge and the South Boston industrial area a distant second (2,057). The predicted increases for the other seven pairs are below 1,600 each.

Environmental Justice

The federal government defines environmental justice (EJ) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, education level, or income with respect to the development, implementation, and enforcement of environmental laws. The MBTA

monitors EJ through implementation of and reporting for Title VI of the Civil Rights Act of 1964.

The Southeast Corridor encompasses several of Boston's densely populated neighborhoods: South Boston, Dorchester, and Mattapan. Almost all of Dorchester and all of Mattapan are classified as minority areas for Title VI, and parts of both are also classified as low-income. The portion of South Boston adjacent to Dorchester is also both minority and low-income. Several other municipalities in the Southeast Corridor include census tracts that are classified as minority: Bridgewater, Brockton, Milton, Quincy, and Randolph. Brockton and Quincy also include census tracts that are classified as both minority and low-income.

Over 30 bus routes operate in this corridor; 14 are classified as minority routes, and 5 are classified as both minority and low-income.

The Red Line's Braintree and Ashmont branches operate in the Southeast Corridor, as does the Mattapan High Speed Line, which connects to the Red Line at Ashmont. Six of the Red Line stations and three of the Mattapan High Speed Line stations (not including Ashmont) in this corridor are classified as minority.

The three Old Colony commuter rail lines operate in the Southeast Corridor. One of these, the Middleborough/Lakeville Line, is one of only two commuter rail lines in the whole system that are classified as minority. Four of the stations in this corridor on this line are classified as minority, and one of these stations is classified as both minority and low-income. None of the MBTA's commuter rail lines are classified as low-income.

MOBILITY PROBLEMS AND PROPOSED SOLUTIONS

Capacity Improvements Are Needed

Investments Will Be Needed to Ensure that Sufficient Capacity Is Available to Serve Current and Projected Travel Demand.

Problem 1:

As indicated above, by 2030 the largest growth in intratown trips is projected for areas that currently have limited existing transit services and, therefore, very low transit mode shares. In Weymouth, which has the third-largest projected intratown travel increase in the Southeast Corridor, transit use currently accounts for only 1% of commuting trips and less than 0.5% of all trips. Current MBTA services in the north part of Weymouth include the new Greenbush commuter rail line, with 2 stations, and bus Routes 220, 221, and 222. Route 225 extends for a short distance into the northwest part of town,

Hingham, with the fourth-largest projected increase in intratown trips in the corridor, also has limited transit coverage, and a transit mode share of less than 1% for all trips made within the town. MBTA Route 220 runs across the north side of town and connects at Hingham Center with Route 714, and Route 222 extends into Hingham on the west side of town for a very short distance. The Greenbush commuter rail line stops at West Hingham and Nantasket Junction stations in the north part of town.

Proposed Solution:

Expand MBTA fixed-route service (or partner with local social service providers, town officials, and the Boston Region Metropolitan Planning Organization (MPO) to institute a new demand-responsive service) to connect densely developed residential areas with key activity hubs (including employment, commercial, and educational hubs) along the Route 3 corridor, especially in South Weymouth.

Problem 2:

By 2030, ridership demand on the Middleborough/Lakeville Line is projected to exceed capacity if six-car trains are still in use then.

Proposed Solution:

Extend the platform used by this line at South Station so that trainsets longer than six cars could be used.

Problem 3:

Modeling projections suggest that by 2030, growing demand on three bus routes in the Southeast Corridor may cause passenger-crowding levels that would trigger the need for additional service. These include:

- Bus Route 19 – Fields Corner Station - Ruggles Station via Grove Hall
- Bus Route 22 – Ashmont Station – Ruggles Station via Jackson Square Station
- Bus Route 28 – Mattapan Station – Ruggles Station via Dudley

All three of these routes provide circumferential connections between the Southeast and Southwest Corridors.

Proposed Solutions:

- Purchase sufficient additional vehicles to increase peak-period capacity and to ensure that future vehicle loads do not exceed safe and comfortable levels on these three routes. To do so, six additional 40-foot buses would be required. Replacing existing 40-foot buses with 60-foot buses would be another way to increase capacity to meet demand. (Routes 19, 22, and 28 also operate in the Southwest Corridor; those routes are discussed in the Southwest Corridor document on problems and proposed solutions.)
- Implement the Urban Ring and other possible circumferential service.
- Extend BRT service from Dudley Square south along Warren Street to Grove Hall, continuing on Blue Hill Avenue to Mattapan Station and on Washington Street to Ashmont Station.

Problem 4:

Significant improvements in transit service have been made in this corridor over the last several years. The commuter rail system was expanded with the re-opening of the Middleborough/Lakeville and Plymouth/Kingston lines in 1997 and the Greenbush Line in late 2007. However, some desirable destinations in the southeast do not have direct rail transit service to Boston. Although they are currently beyond the boundaries of the MBTA's service area, New Bedford and Cape Cod are areas that could benefit from service extensions.

Proposed Solution:

Implement the South Coast Rail project to Fall River and New Bedford.

Problem 5:

Densely populated areas currently served by Silver Line Washington Street lack direct transit connections to jobs and travel at Logan Airport and to the jobs in the rapidly growing South Boston Waterfront.

Proposed Solution:

Implement the Silver Line Phase III project.

Problem 6:

Very densely populated areas in the corridor are currently served by MBTA bus Routes 23 and 28, but do not have frequent rapid transit access within a reasonable walking distance (one-fourth mile). In addition, travel times on Routes 23 and 28 are long and unreliable, and Route 23 has difficulty meeting demand because of its use of 40-foot buses in mixed traffic.

Proposed Solutions:

- Extend BRT service from Dudley Square south along Warren Street to Grove Hall, continuing on Blue Hill Avenue to Mattapan Station and on Washington Street to Ashmont Station.
- Fairmount Line Improvements: four stations. This project is a State Improvement Plan (SIP) commitment.

Problem 7:

Considerable residential growth has occurred in southern Middleborough, Wareham, and Bourne over the past decade, with substantial portions of these new residents commuting to Boston and Cambridge. However, no direct rail connections exist between these communities and the urban core.

Proposed Solution:

Extend commuter rail from Middleborough to Wareham.

Problem 8:

Capacity enhancements on the Old Colony Lines are limited by sections of single track.

Proposed Solution:

Double-track approximately 12 miles between South Station and Braintree, 24 miles on the Lakeville Line between Braintree and Lakeville, 22 miles on the Plymouth/Kingston Line between Braintree and Plymouth, and 17.5 miles on the Greenbush Line between Braintree and Greenbush.

Access to MBTA Services Needs to Be Improved

ADA Accessibility

Problem:

The MBTA has made strides toward providing ADA accessibility to all of its services. All stations on the three commuter rail lines in the corridor are now accessible. One Red Line station, Wollaston, is not yet accessible, but funds have been programmed in the CIP for design work to make it so. On the Mattapan High Speed Line, Valley Road Station has not yet been made accessible.

Proposed Solution:

Valley Road Station is not a high priority for immediate accessibility improvements due to very low ridership and the nearby terrain.

Station Parking

Problem 1:

Access to rail transit services for customers of all abilities is constrained by the availability of parking for automobiles. Currently, parking is at or near capacity at most Red Line and Old Colony stations.

An inventory of station parking that was completed during the fall of 2005 and winter of 2006 shows that parking at the following stations is utilized at 85% of capacity or greater.[5] (See Table F-1.)

TABLE F-1
Southeast Corridor
Station Parking at 85% Usage or Greater

Line	Station	2003 PMT Parking Enhancement Priority
Plymouth/ Kingston Line	Whitman	High
	Abington	Medium
	South Weymouth	Medium
	Hanson	Low
Middleborough/ Lakeville Line	Middleborough	Low
Red Line	Braintree	High
	Quincy Center	Low
	Wollaston	Low
	North Quincy	Low
Mattapan High Speed Line	Butler	Low
	Cedar Grove	Low
Ferry	Hingham Ferry Terminal	Medium

Proposed Solution:

The MBTA can address inadequate parking capacity either by increasing the number of spaces or controlling demand through measures like raising the price of parking overall or installing automated parking-fee collection at MBTA lots to allow for congestion pricing and to improve enforcement of parking regulations.

When evaluating expansion of parking, it is important to consider the availability of MBTA-owned land, the potential cost of acquiring nearby land, and the potential cost of a multilevel structure.

5 Fijalkowski, Jared, and Ostertog, Heather, *Inventory of Park-and-Ride Lots at MBTA Facilities*, Central Transportation Planning Staff, February 27, 2007.

Based on these and other feasibility criteria, all of the above stations would have some potential for expansion of MBTA parking.

Problem 2:

For some customers, access to rail services is constrained by the lack of bicycle parking. A recent study provided a detailed inventory of bicycle amenities, by MBTA station, that included the location, number, and condition of bike racks, bike rack shelters, and signage directing cyclists to them. The study also noted that, at some stations where bike racks were provided, cyclists did not utilize the racks, but parked their bikes elsewhere.[6] These findings build upon the recommendations of the 2003 PMT to install bike racks at rapid transit and commuter rail stations.

Proposed Solution:

The study recommended that the MBTA continue to expand bicycle parking at stations; however, the MBTA does not currently have a standard for determining what the appropriate number of spaces would be for each station. The study therefore also recommended that the MBTA adopt a standard for providing bicycle parking spaces at transit stations.

In instances where bikes were parked at locations other than at bike racks that were provided, the study made recommendations, based on the type of problem observed, including:

- The rack was in an inconvenient location (e.g., far from the platform)
- The rack was not sheltered from the weather
- The rack was in a secluded location that was difficult to find or might encourage theft
- The rack was damaged or difficult to use

The following specific improvements are recommended for stations at which existing bike racks were not used:[7]

TABLE F-2
Southeast Corridor
Bicycle Parking Improvements

Line	Station	Bicycle Parking Enhancement Recommendation
Red Line	North Quincy	Provide shelter for existing racks.
	Quincy Center	Provide shelter for existing racks.
	Wollaston	Install sheltered racks.
Middleborough/ Lakeville Line	Campello	Relocate existing racks to under the shelter.

Connections with Other RTAs

Problem: The Southeast Corridor is served by two Regional Transit Authorities (RTAs) that provide bus connections to MBTA services. However, current schedules do not provide many opportunities for convenient transfers between RTA and MBTA services in this corridor.

The Brockton Area Transit Authority (BAT) operates a network of bus routes, mostly within the City of Brockton, where it provides connections to the three commuter rail stations on the Middleborough/Lakeville line: Brockton, Campello, and Montello. All 12 of BAT's routes originate at the BAT Intermodal Transportation Centre on Commercial Street in downtown Brockton, opposite Brockton Station. At Brockton Station, three of the four inbound AM peak-period trains have connections of less than 10 minutes from most of the BAT routes. However, connections from outbound PM peak-period trains are not as close or as reliable. Of the other two commuter rail stations in Brockton, Campello is an intermediate stop on one BAT route, and Montello is an intermediate stop on two BAT routes.

6 Fijalkowski, Jared, and Yaitanes, Justin, *2005–2006 Inventory of Bicycle Parking Spaces and Number of Parked Bicycles at MBTA Stations*, Central Transportation Planning Staff, October 2, 2007, Table 6.

7 Ibid.

One BAT route provides a connection to the Red Line at Ashmont Station. As with commuter rail, connections in the AM are more reliable than those in the PM, and the total trip time from Brockton Station to South Station is over an hour. Another BAT route provides a potential connection on two trips during the AM peak period, and two in the PM peak period, with MBTA bus Route 230 at Lisa Drive and Howard Street in Brockton, on the border of Holbrook. Route 230 runs between Montello Station and the Quincy Center Red Line station with an intermediate stop at the Braintree Red Line terminal.

The Greater Attleboro Taunton Regional Transit Authority (GATRA) operates a network of five bus routes that serve Kingston and Plymouth and provide connections to the Kingston and Plymouth commuter rail stations on the Plymouth/Kingston line. All of the GATRA routes originate in Plymouth Center and operate on one- or two-hour headways. Two of the routes stop at Kingston Station and at Cordage Park, where Plymouth Station is located. One route provides connections to two inbound AM peak-period trains at Kingston Station, and the other provides a link to the first outbound PM peak-period train.

GATRA also operates a downtown Middleborough area shuttle. The Middleborough/Lakeville commuter rail station is not on the basic bus route, but is served by a side-diversion on two northbound trips and three southbound trips. The shuttle schedule, however, does not coordinate well enough with train arrival and departure times to provide reasonable connections for commuting.

Proposed Solution:

Although the Southeast Corridor is served by BAT and GATRA, current schedules provide few close connections between RTA and MBTA services. In general, RTA bus routes do not function well as commuter rail feeders, as they serve different functions and populations. Most RTA routes provide local service on even headways, while commuter rail provides long-distance commuter service and operates on uneven headways due to a number of equipment and operational constraints. In addition, because RTA routes have frequent stops and many do not provide direct service to stations, using them to access stations is much slower than driving.

Adjusting the RTA services to meet the commuter rail schedules would inconvenience customers making local trips. Changing the commuter rail schedules to coordinate with RTA services would require significant capital and operating costs without significantly improving service for most commuter rail riders. The best solution, therefore, would be to create RTA feeder services to commuter rail.

The MBTA should work with GATRA and with BAT to select one or more stations on the Plymouth/Kingston Line and one or more stations on the Middleborough/Lakeville Line, respectively, and to determine the number and alignment of routes that would be required to provide adequate feeder services.

The 2003 PMT evaluated and recommended two commuter rail feeder routes to two stations on the Plymouth/Kingston Line that do not currently have bus connections: one from Hanover via Rockland to Abington station, and the other from South Duxbury via Pembroke to Hanson Station.

Infrastructure Enhancements Are Needed

Problem:

In order to continue to maintain and improve service quality as ridership grows and as technologies and materials improve, the MBTA will need to continually invest in infrastructure enhancements.

Proposed Solution:

The following table shows some of the enhancement projects that have been identified as future needs:

TABLE F-3
Southeast Corridor
Infrastructure Enhancement Projects

RED LINE	
Asset Category	**Project Description**
Communications	Install single-mode fiber-optic cable along the Red Line.
Facilities	Implement Phase II of the Red Line ventilation improvements, which includes additional vent shafts in the tunnel between Broadway and Charles/MGH stations.
Power	Replace all 125-volt DC emergency lighting systems at some stations on the Red Line.
Signals	Consolidate the cable plant and signal houses at the JFK/UMass and North Quincy stations on the Red Line.
COMMUTER RAIL	
Asset Category	**Project Description**
Facilities	Extend cables at the Kingston layover facility on the Plymouth/Kingston Line to allow for proper positioning of trainsets on layover tracks.
Maintenance facilities	Construct additional midday storage for commuter rail trains used in south-side operations.
Power	Install ventilation fans at the Middleborough and Kingston layover facilities.
Signals	Implement Phase II of the South Bay Track & Signal project, including the installation of three additional signal interlockings and minor track work leading into the storage and inspection facility in South Boston. This work will support additional system expansion on the south side.

A State of Good Repair Needs to Be Achieved

Problem:

A number of system preservation projects must be addressed in the short- to mid-term to bring the system into a state of good repair and to ensure the safety of passengers and reliability of service.

Proposed Solution:

Some of the specific projects needed to bring the system into a state of good repair and maintain it in that condition are included in Table F-4.

TABLE F-4
Southeast Corridor
State-of-Good-Repair Projects

BUS	
Asset Category	**Project Description**
Maintenance facilities	Upgrade/repair Cabot and Quincy bus garages
MATTAPAN HIGH SPEED LINE	
Asset Category	**Project Description**
Revenue Vehicles	Replace PCC cars
RED LINE	
Asset Category	**Project Description**
Bridges	Rehabilitate two bridges on the Red Line (plus one on the Mattapan High Speed Line) that are rated structurally deficient.
Maintenance facilities	Rehabilitate the Cabot facility on the Red Line: expand the shop, the office, and staff facilities.
Power	Replace DC breakers at the Cabot facility switch houses on the Red Line.
Revenue vehicles	Replace Red Line cars to allow the retirement of the No. 1 fleet, which was purchased in 1969.
Signals	Upgrade the signal system at Ashmont Station and at the junction of the Ashmont and Braintree branches.
Stations	Upgrade Wollaston Station to alleviate flooding and drainage problems
Track/right-of-way	Reconstruct the Red Line track at the Clayton Street curve (in Dorchester) to eliminate speed restrictions (correct for deferred maintenance).
Track/right-of-way	Surface, and tamp the tracks and thermit weld the rail to improve the quality of service on the Red Line.
Track/right-of-way	Deactivate Red Line switches that do not meet track standards.
Track/right-of-way	Replace the existing 150-pound-type third rail with new 85-pound-type third rail on the Ashmont Branch of the Red Line. This would combine a lighter type of third rail and improved electrical technology to deliver third-rail power and to improve traction on this section of track.
COMMUTER RAIL	
Asset Category	**Project Description**
Bridges: Fairmount Line	Replace/rehabilitate 10 bridges on the Fairmount Line that are rated structurally deficient.
Facilities: Needham Line	Replace the retaining wall behind the mini-high-level platform at Needham Heights Station on the Needham Line, which has reached the end of its useful life.
BOAT	
Asset Category	**Project Description**
Docks	Repair/replace boat docks at Quincy, Long Wharf, and Hingham Ship Yard.

Appendix G

Central Area:

Boston Proper and Circumferential Mobility Problems and Proposed Solutions

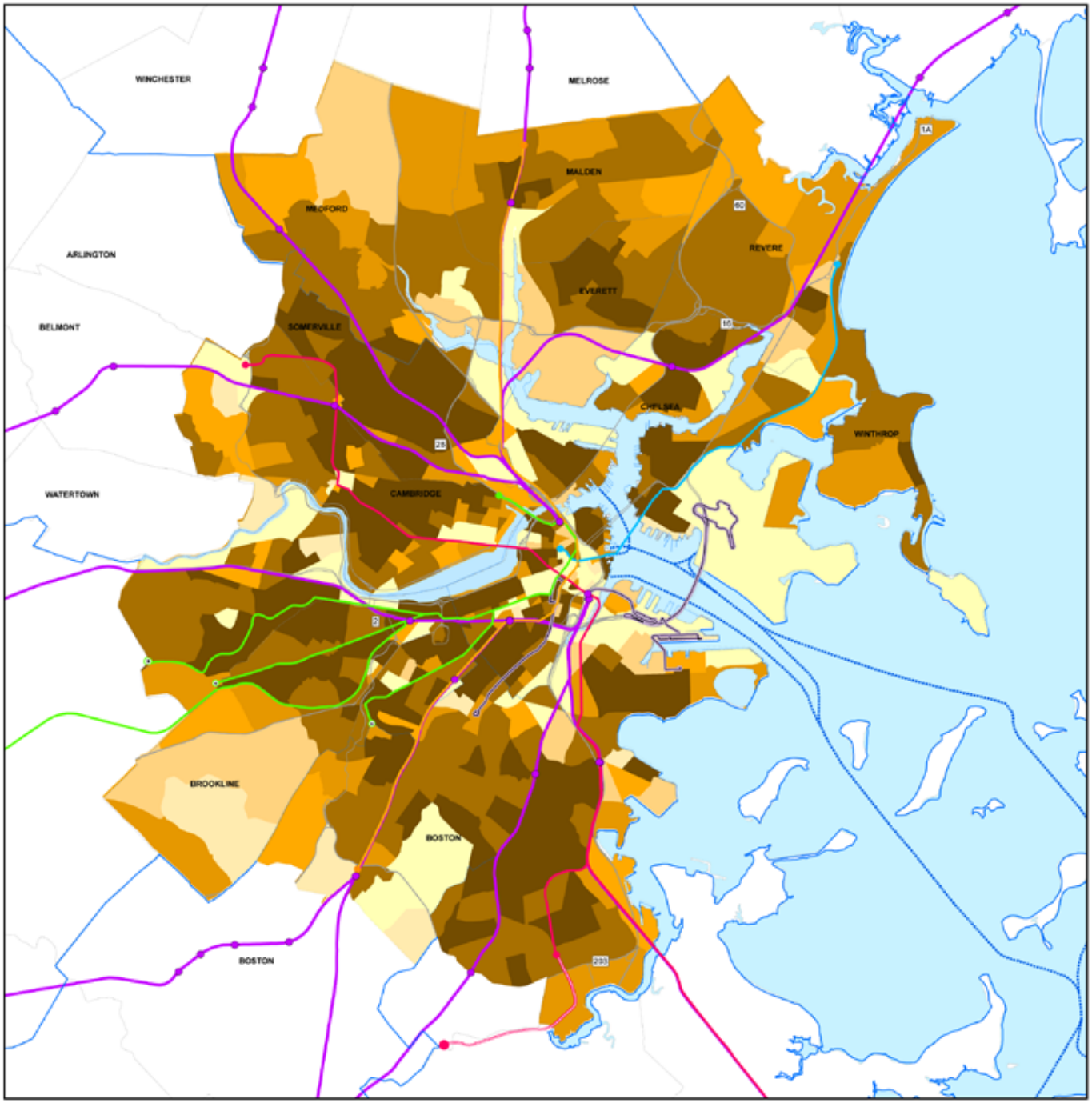
BACKGROUND

Existing Conditions

The Central Area consists of most of Boston (excluding Hyde Park, Roslindale, West Roxbury, and Mattapan) and nine communities surrounding the city: Brookline, Cambridge, Somerville, Medford, Malden, Everett, Chelsea, Revere, and Winthrop. Most parts of the Central Area are also the close-in components of the six radial corridors. The exception is Boston Proper, which is not included in any radial corridor. Boston Proper is the part of the city that lies northeast of Massachusetts Avenue and is bordered by the Charles River, Boston Harbor, Fort Point Channel, and the Southeast Expressway.

All five rapid transit lines, plus the two commuter rail systems, converge in Boston Proper. The oldest parts of the system, the heaviest ridership, and the most serious congestion in stations and terminals occurs in Boston Proper. Consequently, adequate corridor coverage is not an issue in the way it is in the geographically extensive radial corridors. Instead, capacity, modernization, and connectivity define the challenges the MBTA faces here.

The Central Area encompasses most of the rapid transit system and much of the local bus network. Of the rapid transit system, only the Riverside Branch of the Green Line, the Mattapan High Speed Line, and Braintree Branch of the Red Line extend beyond the Central Area. The commuter rail system has three stations in Boston Proper: North Station, South Station, and Back Bay Station. While most commuter rail lines extend deep into the radial corridors, there are some commuter rail stations beyond Boston Proper that are in the Central Area: Chelsea, Malden Center, West Medford, Porter Square, Yawkey, Ruggles, Forest Hills, Uphams Corner, and JFK/UMass.



MAP G-1
Central Area of the MBTA Service Area

Population Density, 2000

U. S. Census 2000
Population/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 20,000
- 20,001 - 175,061

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

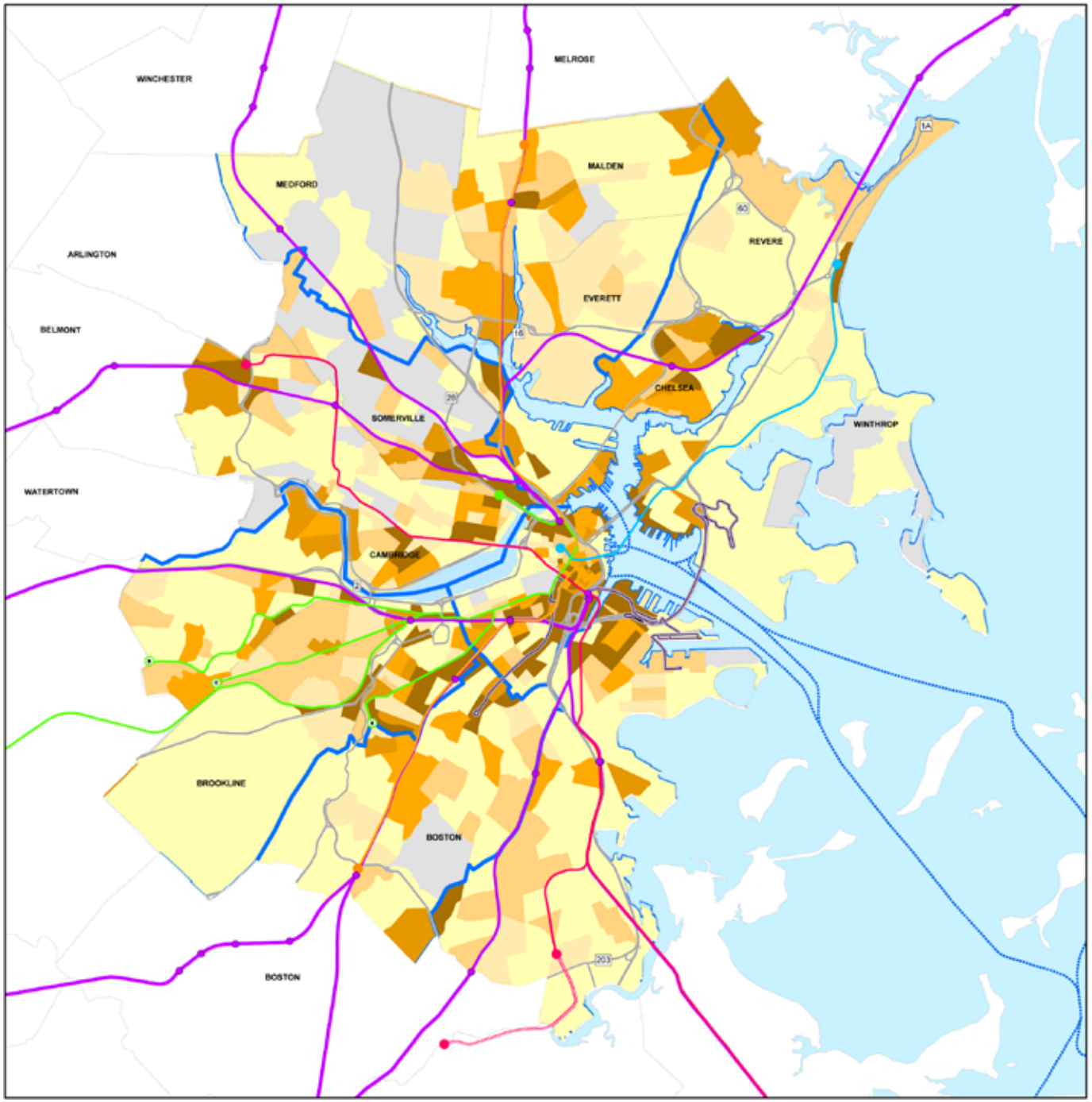
- Commuter rail line

0 0.45 0.9 1.8 Miles

MBTA Program for Mass Transportation

March 2008

N



MAP G-2
Central Area
of the MBTA Service Area

Projected Change in Population Density from 2000 to 2030

2030 MetroFuture Projection
Change in Population/Sq. Mi. by TAZ

- -4,086 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 164,061

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Mattapan High Speed Line
- Red Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 0.45 0.9 1.8 Miles

MBTA Program for Mass Transportation

March 2008

N

Because of the relatively high availability of transit services in the Central Area, the transit share of trips is substantially higher than in the outlying parts of the MBTA service area. The rapid transit and bus services across the Central Area, and commuter rail ridership at stations in Boston Proper, are responsible for this high transit share. The Central Area commuter rail stations outside of Boston Proper do not generate ridership nearly as significant as the other MBTA markets do. These stations are, however, considered promising sites for future transit-oriented development, and as such are discussed thoroughly in the analyses of radial corridors.

As the mode share estimates indicate, the radial nature of the MBTA system works well for commuters who live in the Central Area and work in Boston Proper. However, as the region has grown, particularly in suburban areas, demand has increased for travel to and between areas outside of Boston Proper. Proposals to better serve circumferential travel corridors are presented in this section.

Population

Many of the most densely populated communities and neighborhoods in the MBTA's service area are located in the Central Area (see Map G-1). Although most Central Area communities have zones where population densities are projected to remain relatively stable over the next 25 years, all but Winthrop also have areas where densities are expected increase substantially. The largest increases in population density are projected to occur in zones in Boston Proper, Allston/Brighton, Cambridge, Chelsea, Revere, and Somerville. (See Map G-2.)

According to the U. S. Census, the Central Area's 2000 population was 983,445. By 2030, this number is projected to increase 17% to 1,155,088.[1] Overall, 60% of the Central Area's growth will occur in Boston neighborhoods, with the highest rate of growth in the areas of Boston that are not currently as densely populated: South Boston is expected to increase by 79% (mostly within the rapidly developing Waterfront area), while population in Boston Proper itself will increase by 85%. Outside of Boston, Cambridge and Somerville will experience the highest rate of population growth, increasing by 22% and 24% respectively. (See Figure G-1.)

FIGURE G-1
Central Area 2000-2030 Population Growth
Top Ten Communities/Neighborhoods
in Order of Increase

Many of the larger housing developments planned, proposed or under development in the in the Central Area are transit oriented: NorthPoint adjacent to the Green Line Lechmere Station in East Cambridge, Somerville and Boston with 2,500 residential units; Assembly Square, which includes a proposed new Orange Line Station

1 Metropolitan Area Planning Council (MAPC) population and employment forecasts.

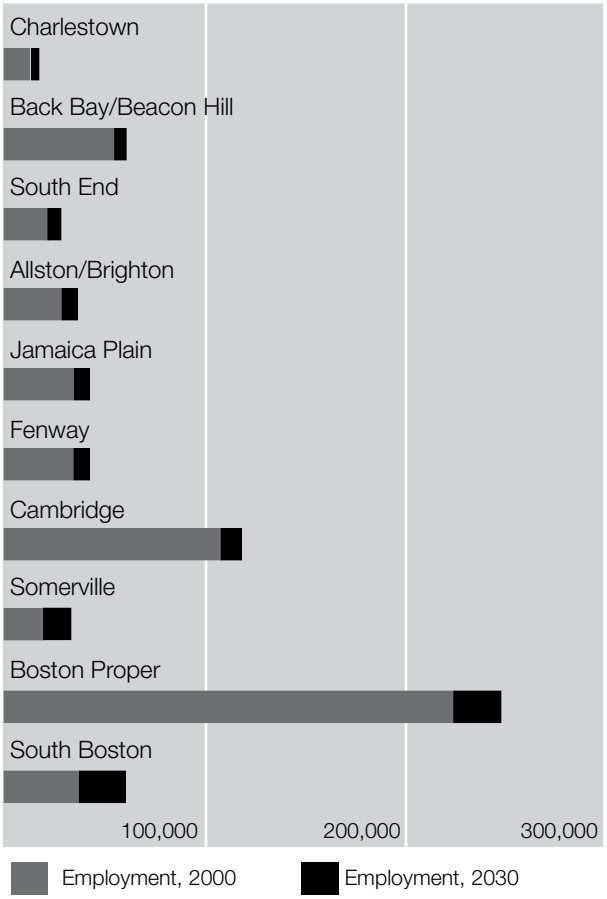
in Somerville and 1,332 housing units; the Blue Line Wonderland Station development in Revere with 902 units; and the Orange Line Forest Hill Station development in Jamaica Plain with 730 units.

Employment

Concentrations of dense employment are found not only in Boston neighborhoods, but are also scattered throughout almost all Central Area communities (see Map G-3). The pockets of highest employment density increases have been projected for Boston, Cambridge, Somerville, and Revere. Stable or moderate changes in employment density are projected for most of Medford and Revere. Employment densities have been projected to decrease in large parts of Brookline, Boston, Cambridge, Malden, and Everett. (See Map G-4.)

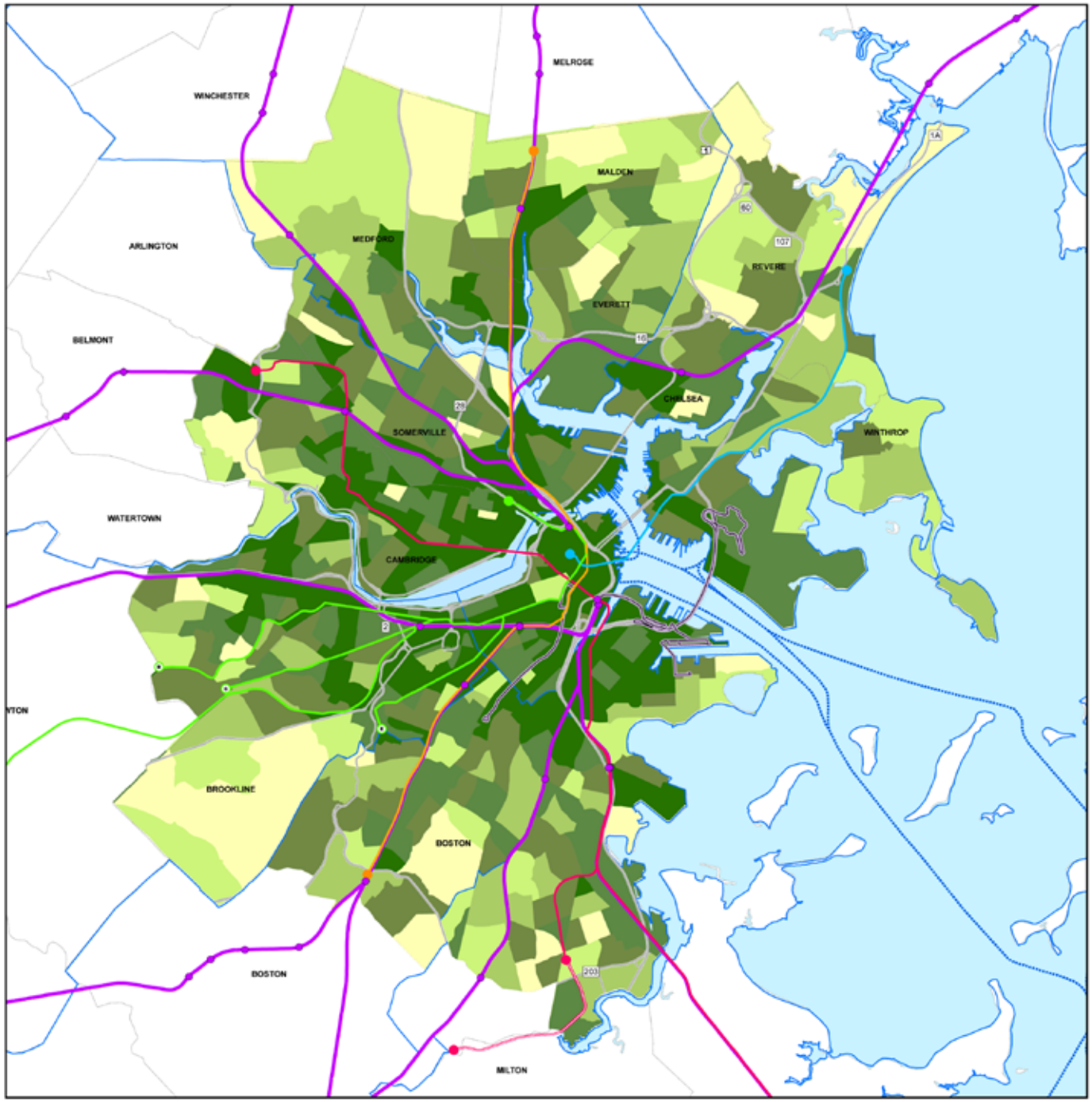
Overall, the number of jobs in the Central Area is projected to increase by 15% between 2000 and 2030. More than 90% of this growth is expected to occur in Boston, with most of the other communities experiencing modest growth in absolute terms.[2] Despite projected citywide employment growth in Boston and Cambridge, parts of both cities are projected to experience employment decline. Minor citywide losses have been projected for Everett and Malden. (See Figure G-2.)

FIGURE G-2
Central Area 2000-2030 Employment Growth
Top Ten Communities/Neighborhoods
in Order of Increase



As with housing, the larger envisioned employment developments in the corridor are transit oriented, and include North Point, a partially completed development adjacent to the Green Line's Lechmere Station, whose building will be located in East Cambridge, Somerville, and Boston, with 2.2 million square feet of office space as well as residential units; Fan Pier and Waterside Place, both served by the Silver Line in South Boston, with 1.2 million square feet of office space and .75 million square feet of retail space, respectively; the Hines development at South Station, which is served by the Red Line, Silver Line, and commuter rail, with over 1 million square feet of office space; and Assembly Square, in Somerville, which includes a proposed new Orange Line station and one million square feet of retail space.

2 Ibid.



MAP G-3
Central Area of the MBTA Service Area

Employment Density, 2000

2000 CTPS Employment Database
Employees/Square Mile by TAZ

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 1,000,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

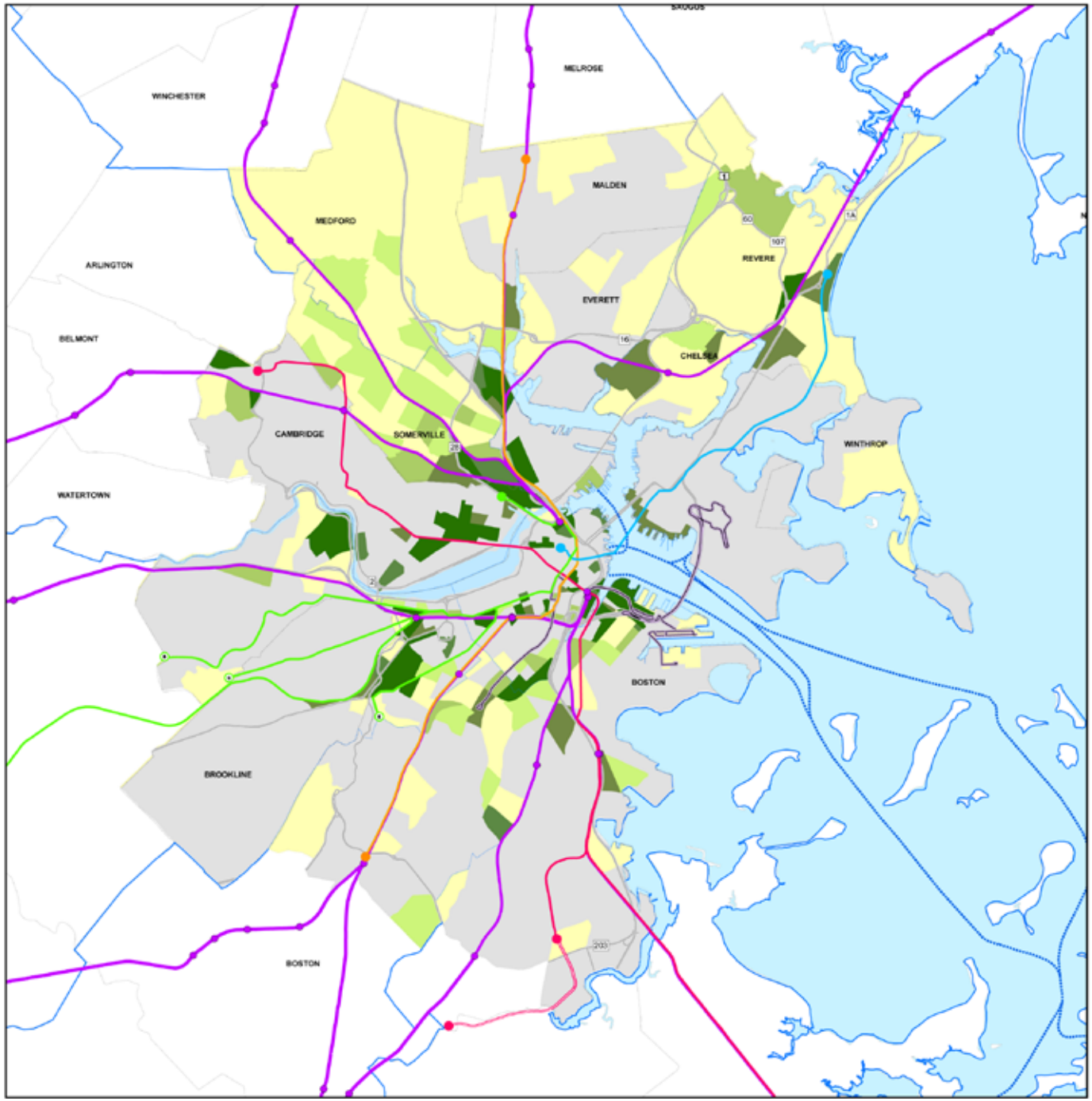
- Commuter rail line

0 0.4 0.8 1.6 Miles

N

MBTA Program for Mass Transportation

March 2008



MAP G-4
Central Area
of the MBTA Service Area

Projected Change in Employment Density from 2000 to 2030

2030 MetroFuture Projection
Change in Employees/Sq. Mi. by TAZ

- -94,000 - 0
- 1 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 400,000

Rapid Transit

- Blue Line
- Green Line
- Orange Line
- Red Line
- Mattapan High Speed Line
- Silver Line

Commuter Boat

- Commuter boat route

Commuter Rail

- Commuter rail line

0 0.25 0.5 1 Miles

MBTA Program for Mass Transportation

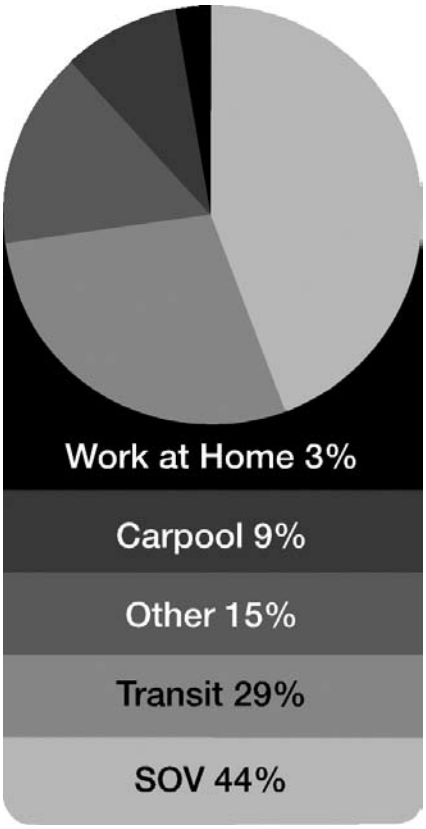
March 2008

N

Journey to Work

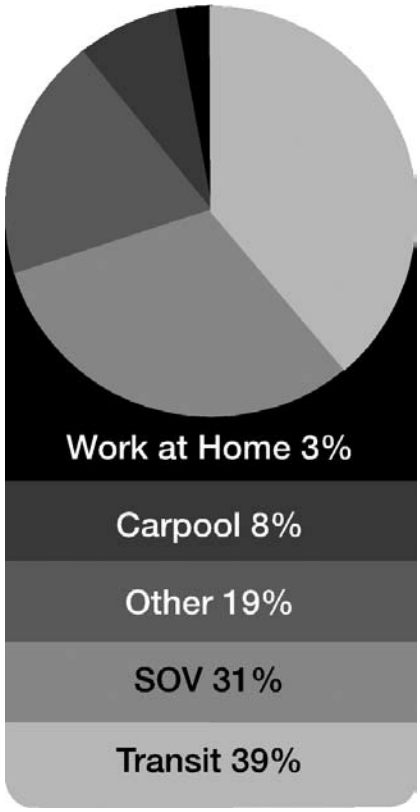
Nationally, work trips comprise a small proportion—15 %—of all trips.[3] Because most commuting occurs during peak travel times, work trips determine the capacity needs, as well as the performance, of highway and transit systems. Forty-four percent of all work trips that originated in the Central Area were made in single-occupancy vehicles (SOVs) in 2000, and 29% were made by transit. (See Figure G-3.)

FIGURE G-3
2000 Travel Modes to Work by Central Area Residents



A majority of area residents' work trips, 62%, have destinations in Boston and Cambridge. Because of the concentration of MBTA service in the Central Area, almost 40% of these trips are made on transit, while only around one-third are by SOVs. (See Figure G-4.)

FIGURE G-4
2000 Travel Modes to Work to Boston and Cambridge by Central Area Residents



Travel Projections

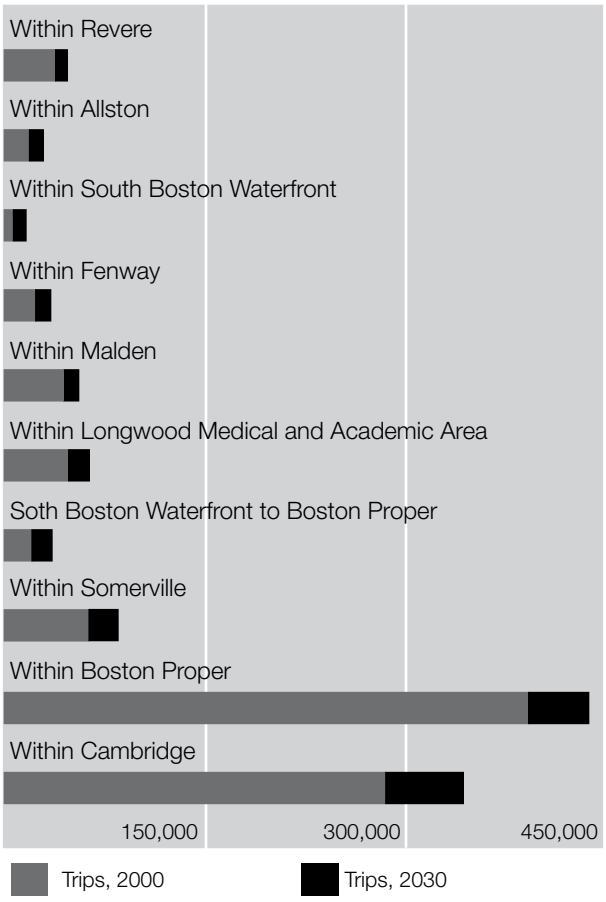
The CTPS Regional Travel Demand Model provides estimates of current travel volumes and projections of future travel volumes for all major modes: auto, transit, and walk/bike. A useful way of tracking travel growth patterns is to look at the change in travel between pairs of municipalities, and to include trips beginning and ending in the same municipality. By 2030, it is projected that there will be 57 travel pairs in the Central Area with predicted increases of at least 1,000 two-way trips per day. The projected travel volume increase for these 57 pairs is 367,772 trips per day (approximately 21%).

Of the 57 pairs with projected travel volume increases of over 1,000, 20 are in trips entirely within one municipality or one Boston neighborhood, and 24 are between directly adjoining municipali-

3 Transportation Research Board, *Commuting in America III: The Third National Report on Commuting Patterns and Trends*, NCHRP Report 550, October 2006, p. 3.

ties or Boston neighborhoods. The largest increases in the Central Area are trips made entirely within Cambridge (58,013), within Boston Proper (44,323), within Somerville (21,803), between Boston Proper and the South Boston Waterfront (15,870), within the Longwood Medical and Academic Area (15,541), within Malden (11,845), within the Fenway neighborhood (10,597), within the South Boston Waterfront (10,065), and within Allston (9,964). (See Figure G-5.)

FIGURE G-5
Central Area Trip Increases 2000-2030
Top Ten Communities/Neighborhoods in Order of Increase



Environmental Justice

The federal government defines environmental justice (EJ) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, education level, or income with respect to the development, implementation, and enforcement of environmental laws. The MBTA monitors EJ through implementation of and reporting for Title VI of the Civil Rights Act of 1964.

Boston Proper encompasses the densely populated neighborhoods of the North End, West End, South End, Back Bay, Beacon Hill, and Chinatown. Parts of Boston Proper are classified as minority areas or as both low-income and minority areas for Title VI.

Fifty-five bus routes run through this corridor, 30 of which are classified as minority and 17 as both minority and low-income.

The Silver Line Washington Street BRT line operates in this area. All nine Silver Line stops in Boston Proper are classified as minority, and five of these are classified as both minority and low-income.

All rapid transit lines operate in this area. Thirteen of the rapid transit stations in Boston Proper are classified as minority, and six of these are classified as low-income as well.

Additionally, both termini and one additional station for the region's commuter rail lines are located in Boston Proper. EJ discussions for the Central Area municipalities that lie outside of Boston Proper are included in the applicable radial corridor appendices.

BOSTON PROPER MOBILITY PROBLEMS AND PROPOSED SOLUTIONS

Capacity Improvements are Needed

Investments Will Be Needed to Ensure that Sufficient Capacity Is Available to Serve Current and Projected Travel Demand.

Problem 1:

Currently, travel by MBTA between the Back Bay, Roxbury, Fenway, Brookline, and Newton to Logan Airport, the Boston Convention and Exhibition Center, and the rapidly developing South Boston Waterfront is a "three-seat ride." This negatively impacts the convention-dependent hospitality industry, as well as severely inconveniencing air travelers, workers, and residents.

Proposed Solution:

Implement the Silver Line Phase III project.

Problem 2:

Transit travel to the business districts in Cambridge—especially near Kendall and Harvard Squares—is currently difficult for East Boston and North Shore residents. In addition, Cambridge residents do not have direct rapid transit access to the northern part of the financial district near State and Aquarium Stations on the Blue Line.

Proposed Solutions:

- Build a pedestrian tunnel between State Street and Downtown Crossing Stations.
- Red Line–Blue Line rail connector.

Problem 3:

Very densely populated areas of Roxbury and Dorchester are currently served by MBTA bus Routes 23 and 28. These heavily used routes terminate at Ruggles Station on the Orange Line, where large numbers of riders transfer in order to travel to Boston Proper. The neighborhoods served are not within a reasonable walking distance (one-fourth of a mile) of conventional rapid transit services, the routes are long and unreliable, and Route 23 has difficulty meeting demand since it uses 40-foot buses in mixed traffic.

Proposed Solution:

Extend BRT service from Dudley Square south along Warren Street to Grove Hall, continuing on Blue Hill Avenue to Mattapan Station and on Washington Street to Ashmont Station.

Problem 4:

The lack of a direct connection between North and South Stations makes many types of trips cumbersome using transit. North-side commuter rail users need better direct access to the Back Bay (and the Ruggles area and Longwood Medical and Academic Area). Commuters on the south-side lines currently must transfer to travel via rapid transit from South Station to Government Center and areas further north in Boston.

Proposed Solution:

Build the North-South Rail Link.

Problem 5:

Track capacity at South Station limits service expansion.

Proposed Solution:

Add tracks as a component of the redevelopment of the U.S. Postal Service South Station Annex.

ADA Accessibility Needs to Be Improved

Problem:

Although the MBTA has made strides toward providing ADA accessibility to all of its services, some gaps still remain. On the Green and Blue Lines, Government Center Station, and on the Green Line, Science Park and Boylston Stations, have not yet been made accessible.

Proposed Solution:

All of these stations are high priority for near-term accessibility improvements.

Infrastructure Enhancements Are Needed

Problem:

To improve service capacity and flexibility, more Green Line trains need to be able to reverse direction at Park Street.

Proposed Solution:

Park Street crossover tracks on Green Line.

A State of Good Repair Needs to Be Achieved

Problem:

The signal system in the Green Line Central Subway dates from the 1920s.

Proposed Solution:

Replace the Green Line central subway signal system.

CIRCUMFERENTIAL MOBILITY PROBLEMS AND PROPOSED SOLUTIONS

The Boston Region Central Area is home to many major trip generators, including medical, educational, and cultural institutions, densely populated residential areas, and high-density employment and retail. Circumferential travel in the area using the rapid transit system is constrained by the hub-and-spoke nature of the existing network. To make a trip between the spokes using rapid transit, a rider must travel through the congested central subway system, and travel back out to reach the final destination.

As the mode share estimates indicate, the radial nature of the MBTA system works well for commuters who live in the Central Area and work in Boston Proper. However, as the region has grown, particularly in suburban areas, demand has increased for travel to and between areas outside of Boston Proper. Three potential circumferential corridors have been defined that connect existing activity centers:

- The Central Area Circumferential Corridor, which connects activity centers within the Central Area.
- The Inner-Suburban Circumferential Corridor, which connects activity centers within and just outside of the Central Area.
- The Outer-Suburban Circumferential Corridor, which connects activity centers outside the Central Area, but generally within Route 128.

The MBTA operates some circumferential bus connections between rapid transit spokes. However, buses must compete with cars on increasingly congested urban streets, reducing the appeal of these services. Also, more frequent, rapid, and through-routed connections would greatly enhance circumferential mobility.

Circumferential Service Needs to be Improved

Problem:

Historically, the primary trip attractions in Boston Proper developed along an axis that included Government Center, the Financial District, and Downtown Crossing. Over time, this axis expanded west toward the Back Bay. The Prudential and Copley Place developments, as well as the relocation of the Orange Line to the Southwest Corridor, firmly defined this still-unfolding "high spine" development pattern for Boston.

At the same time, the educational activity centers to the northwest along the Red Line in Cambridge, as well as the medical and education complexes in the Longwood Medical and Academic Area southwest of the Back Bay continued to develop. West of Boston Proper is the transforming industrial area of Allston Landing. Harvard's envisioned expansion at Allston Landing will make the institutional presence between Harvard Square and the Longwood area almost continuous, creating a well-defined inner circumferential corridor.

The Urban Ring project has identified the following activity centers within the Central Area that would benefit from improved circumferential transit connections. These are listed in Table G-1.

TABLE G-1
Urban Ring Activity Centers

Activity Center	Corridor
Logan Airport, East Boston	Northeast
Bellingham Square, Chelsea	Northeast
Wellington Station, Medford	North
Sullivan Station, Charlestown	North
Lechmere/NorthPoint, Cambridge	Northwest
Kendall Station, Cambridge	Northwest
Harvard Station, Cambridge	Northwest
Allston Landing	West
BU/Kenmore	West
Yawkey Station/Fenwood Center	West
Fenway Station	West
Longwood Medical & Academic Area	West
Ruggles Station	Southwest
Dudley Station	Southwest
Uphams Corner	Southeast
JFK/UMass Station	Southeast

Existing circumferential services that directly connect these activity centers include:

Northeast Corridor: There are no direct transit connections between the two activity centers in the Northeast Corridor: Logan Airport and Bellingham Square.

Northeast and North Corridors: Bus Route 112 connects Bellingham Square in Chelsea via Everett Square, both in the Northeast Corridor, with Wellington Station in the North Corridor.

North Corridor: In the North Corridor, the Orange Line connects Wellington Station with Sullivan Station, both of which are in the North Corridor.

North and Northwest Corridors: Bus Route 86 connects Sullivan Station in the North Corridor with Harvard Square in the Northwest Corridor, and with Allston Landing in the West Corridor. Bus Route CT2 connects Sullivan Station with Kendall Station in the Northwest Corridor.

North, Northwest, and West Corridors: Bus Route 86 connects Sullivan Station in the North Corridor and Harvard Square in the Northwest Corridor with Allston Landing in the West Corridor.

Northwest Corridor: In the Northwest Corridor, Route 69 connects Lechmere Station and Harvard Square. The Red Line connects Kendall and Harvard Squares.

Northwest and Southwest Corridors: Route 1 provides a connection between Harvard Square in the Northwest Corridor and Dudley Square in the Southwest Corridor.

West Corridor: In the West Corridor, Route 8 connects Kenmore Square with the Longwood Medical and Academic Area (LMA). Route 47 and the CT2 connect BU, Fenway, and the LMA.

West and Southwest Corridors: Routes 8, 19, and CT3 connect Kenmore Square and the LMA in the West Corridor with Ruggles and Dudley Stations in the Southwest Corridor.

West, Southwest, and Southeast Corridors: Route 8 also connects Kenmore Square and the LMA in the WestCorridor with Ruggles and Dudley Stations in the Southwest Corridor, and with JFK/UMass Stations in the Southeast Corridor.

Southwest Corridor: In the Southwest Corridor, Routes 8, 15, 19, 23, 28, 44, 45, and 47 connect Ruggles and Dudley Stations.

Southwest and Southeast Corridors: Route 15 connects Ruggles and Dudley Stations in the Southwest Corridor with Uphams Corner in the Southeast Corridor, and Route 41 connects Dudley Square with Uphams Corner and JFK/UMass Stations in the Southeast Corridor.

Southeast Corridors: In the Southeast Corridor, Route 41 connects Uphams Corner with JFK/UMass Station.

Proposed Solutions:

- Implement the Urban Ring project (numerous elements) and additional bus storage and maintenance capacity to accommodate a larger vehicle fleet.
- Implement elements of BRT on Routes 22 and 66.

- Add an intermodal station in Allston/Brighton area.
- Expand capacity at Ruggles and JFK/UMass Stations to accommodate stops by all commuter rail trains.
- Implement the Silver Line Phase III project.

Inner-Suburban Circumferential Service Needs to be Improved

Problem:

Arlington, Belmont, Watertown, and the Boston neighborhoods of Roslindale, Hyde Park, and Mattapan lie just outside the Central Area. These communities have well-developed activity centers and town centers, and most have good radial transit access to the urban core. However, the further out the spokes of the rapid transit and commuter rail systems radiate, the further apart they become, leaving large geographic areas between them. In addition, as the distance from Boston Proper increases, bus routes become feeding services for the radial rail systems, and transit services form less of an interconnected web. These factors combine to make circumferential mobility via transit more challenging between the communities that surround Boston.

Activity centers have been identified in the inner-suburban circumferential corridor, both within and just outside the Central Area. All six radial corridors have a major inner-suburban activity center. (See Table G-2.)

TABLE G-2
Inner-Suburban Activity Centers

Inner-Suburban Hub	Corridor
Wonderland Station (Revere)	Northeast
Revere Center	Northeast
Everett Square	North
Wellington	North
Medford Square	North
West Medford	North
Linden Square	North
Malden Center	North
Oak Grove	North
Arlington Center	Northwest
Belmont Center	Northwest
Waverly Square	Northwest
Watertown Square	Northwest
Davis Square	Northwest
Porter Square	Northwest
Harvard Square	Northwest
Arlington Heights	Northwest
Alewife Station	Northwest
Brighton Center	West
Cleveland Circle/Reservoir Station	West
Forest Hills	Southwest
Roslindale Square	Southwest
Hyde Park/Cleary Square	Southwest
Mattapan	Southeast
Ashmont	Southeast

Existing circumferential services that directly connect these activity centers include:

Northeast Corridor: The two hubs in the Northeast Corridor, Revere Center and Wonderland, are connected by MBTA bus Routes 116 and 117 during peak and off-peak periods, and also by Route 110 during off-peak periods.

Northeast and North Corridors: Route 411 connects Wonderland in the Northeast Corridor with Linden Square and Malden Center Station in North Corridor.

North Corridor: West Medford and Medford Square are connected by MBTA bus Routes

94 and 95. Bus Route 101 connects Medford Square with Malden Center. Malden Center and Oak Grove (at the Malden-Melrose line) are connected by bus Routes 132, 136, and 137, which parallel the Orange Line at this point. Malden Center is connected with Linden Square (near the Malden-Revere line) by MBTA bus Route 108, and with Everett Square by Routes 97 and 104.

North and Northwest Corridors: The MBTA does not provide any direct connections between identified hubs in the north and Northwest Corridors.

Northwest Corridor: In the Northwest Corridor, the Red Line connects Harvard Square, Porter Square, Davis Square, and Alewife Station. Arlington Center is connected with Alewife Station by Routes 67, 79, and 350, with Davis Square by Route 87, and with Harvard Square by Route 77. Arlington Heights is connected with Arlington Center by Routes 77 and 79, with Alewife by Routes 62, 76, 79, with Arlmont Village by Route 78 during peak periods, and with Harvard Square by Routes 77 and 78. Belmont Center is connected with Harvard Square by MBTA bus Routes 74 and 75. Waverley Square is connected with Harvard Square by trackless trolley Route 73. Belmont Square and Waverley Square are both connected with Porter Square by the Fitchburg commuter rail line.

Northwest and West Corridors: The MBTA does not provide any direct connections between identified hubs in the Northwest and West Corridors.

West Corridor: In the West Corridor, Route 86 connects Reservoir Station with Brighton Center, the only two hubs identified in the West Corridor.

West and Southwest Corridors: Route 51 connects Reservoir Station in the West Corridor with hubs in the Southwest Corridor, including Roslindale Square and Forest Hills Station.

Southwest Corridor: In the Southwest Corridor, Hyde Park/Cleary Square is connected with Roslindale Square by MBTA bus Route 50, and with Forest Hills by Route 50 and Route 32. MBTA bus Routes 30, 34, 34E, 35, 36, 37, 40, 50, and 51 all connect Roslindale Square with Forest Hills Station via the same alignment, making this one of the most frequently served bus corridors in the MBTA system. The Needham commuter rail line also connects these two hubs, but carries few local riders between them.

Southwest and Southeast Corridor: The MBTA does not provide any direct connections between identified hubs in the Southwest and Southeast Corridors.

Southeast Corridor: In the Southeast Corridor, Mattapan Square and Ashmont Station are connected by the Mattapan High Speed Trolley Line and by MBTA bus Route 27.

Proposed Solution:

Implement additional inner-suburban circumferential services to connect all or most of the identified hubs, in conjunction with the creation of comfortable facilities where efficient bus-to-bus transfers can take place and where information can be obtained about the system.

Outer-Suburban Circumferential Service Needs to be Improved

Problem:

Over the past few decades, suburban communities in the MBTA service area along the Route 128 beltway have grown considerably, both in terms of residential expansion and commercial and office development. Many of these suburban communities not only have well developed town or city centers that serve as significant activity hubs, but also have major shopping centers, office parks, and even high-rise office buildings that now form “linear centers” along Route 128. As a result of this development, substantial intra-suburban travel demands have developed in a nominally circumferential sense. Transit connections between emerging centers in these outer-suburban areas are relatively scarce.

The activity centers in the outer-suburban circumferential corridor have been identified. All six radial corridors have a major outer-suburban activity center. (See Table G-3.)

TABLE G-3
Outer-Suburban Activity Centers

Outer-Suburban Hub	Corridor
Central Square (Lynn)	Northeast
Square One Mall (Saugus)	Northeast
Salem Center	Northeast
North Shore Mall (Peabody)	Northeast
Franklin Square (Melrose)	North
Winchester Center	North
Wakefield Square	North
Woburn Square	North
Burlington Mall	North
Lexington Center	Northwest
Waltham Center	Northwest
Watertown Square	Northwest
Newton Corner	West
Newton Centre	West
Dedham Mall	Southwest
East Milton Square	Southeast
Quincy Center	Southeast
Weymouth Landing	Southeast

Existing circumferential services that directly connect these activity centers include:

Northeast Corridor: The Square One Mall is connected with Central Square by MBTA bus Route 429. Central Square is connected with Salem Center by the Newburyport/Rockport commuter rail line and by MBTA bus Routes 455 and 456. The North Shore Mall is connected with Salem Center by MBTA bus Route 465 and with Central Square, in Lynn, by MBTA bus Routes 435 and 436.

Northeast and North Corridors: The MBTA does not provide any direct connections between identified hubs in the Northeast and North Corridors.

North Corridor: The Burlington Mall and Woburn Square are connected by MBTA bus Route 354; Woburn Square with Winchester Center are connected by Route 134; and Wakefield Square is connected with Franklin Square by MBTA bus Routes 136 and 137.

North and Northwest Corridors: The town of Lexington's Lexpress minibus service, which is partly funded by the MBTA, has one route that connects the Burlington Mall in the North Corridor with Lexington Center in the Northwest Corridor.

Northwest Corridor: Watertown Square and Waltham Center are connected by MBTA bus Routes 70 and 70A.

Northwest and West Corridors: Routes 553 and 554 connect Waltham Center in the Northwest Corridor with Newton Corner in the West Corridor. Route 52 connects Watertown Square in the Northwest Corridor with Newton Corner and Newton Centre in the West Corridor (and ultimately with the Dedham Mall in the Southwest Corridor).

West Corridor: In this corridor, the only two identified activity centers or hubs, Newton Corner and Newton Centre, are connected by MBTA bus Route 52.

West and Southwest Corridors: Route 52, originating at Watertown Square in the Northwest Corridor, connects Newton Corner and Newton Centre in the West Corridor with the Dedham Mall in the Southwest Corridor.

Southwest Corridor: Only one hub, Dedham Mall, has been defined within the Southwest Corridor, so no intra-corridor connections are defined here.

Southwest and Southeast Corridors: The MBTA does not provide any direct connections between identified hubs in the Southwest and Southeast Corridors.

Southeast Corridor: Quincy Center is connected with East Milton Square by Routes 217 and 245, and with Weymouth Landing by Route 225 and the Greenbush commuter rail line.

Proposed Solution:

Implement additional outer suburban circumferential services to connect all or most of the identified hubs, in conjunction with the creation of comfortable facilities where efficient bus-to-bus transfers can take place and where information can be obtained about the system.

Appendix H

Projects Required for Achieving a State of Good Repair by 2030

The following projects, which are currently unfunded, must be completed to achieve and maintain a state of good repair by 2030. This list does not represent the full universe of projects that will be needed to bring the system into a state of good repair.

Revenue Vehicles

- Procurement of 146 New Orange Line #14 Cars (to Replace #12 Cars)
- Procurement of 480 New Buses
- Bi-Level Coach Procurement (85 Coaches to Replace Pullman Fleet and Support Service Expansion)
- Procurement of 74 New Red Line #4 Cars (to Replace #1 Cars)
- Bus (CNG, Diesel and Electric) Midlife Overhaul
- Midlife Overhaul of 25 GP40-MC Locomotives
- Top Deck Overhaul of 37 F40 Locomotives and Upgrade of 25 Engines to Tier 0 Compliance
- Midlife Overhaul of 75 Bi-Level Kawasaki Coaches
- Coach Reliability and Safety Program (CRASP)
- Lease of 20 Passenger Coaches to Support the CRASP and Kawasaki Coach Overhaul Programs
- Green Line: #8 Primary Suspension Overhaul - Safety/Reliability/Comfort

- Orange Line Bearing Overhaul Program
- Green Line: Type 8 Air Compressor Replacement
- Red Line: #1 Car A/C Motor and Compressor Overhaul
- Red Line: #1 Car Inter-Car Cabling and Automatic Train Operation (ATO) Modification
- Ferry Overhauls
- Orange Line: Improve ATO and Speed Sensors on Vehicles
- Coaches 1607 and 1634 Collision Damage Repair
- Red Line: #1 Car End Door Threshold Repair
- Orange Line: Required Upgrade of Air Compressor
- Replace Inverters on Air Conditioning Units of 25 GP40 Locomotives

Non-Revenue Vehicles

- Non-Revenue Replacement Vehicles
- Blue Line: Procure New Trailer for Orient Heights Transportation Office
- Portable Generator Trailer for 350KW Unit
- Red Line: Fork Truck Replacement

Track/Right-of-Way

- Floating Slabs and Tunnel Leak Repair - Alewife to Harvard
- Rehabilitate Grand Junction Secondary (connecting north and south side commuter rail systems) between the Worcester Line in Allston and the Fitchburg Line in Cambridge
- Install improved pumping station at Natick Station to prevent flooding of tracks
- Ashmont Interlocking Reconstruction
- North Quincy Interlocking Replacement
- Maintenance-of-way (MOW) - Track Division Annual Initiatives Program (i.e., tie replacement, etc.)
- Systemwide Tunnel Lighting
- Yard Switch Replacement and Track Reconstruction
- Replace Layover Facility - Franklin
- Subway Facility Enhancement Program
- Crossover Upgrades (Red Line) at Broadway and South Station
- Clayton Street Curve Rehab (Red Line)
- Green Line Frog Replacement Program
- Permanent Snow Fencing
- Layover Capacity Improvements - Bradford
- Green Line: Replace Sidings at Blandford Street and Northeastern University
- Green Line: Wooden Overhead Trough Removal
- Red Line: Upgrade of Crossovers at Broadway Station, South Station, and Kendall Station
- Feasibility Study - Crossovers at Aquarium and Maverick
- Green Line Crossover Study - Commonwealth Avenue and Beacon Street
- Side Track Study (Green Line)
- Expand Midday Storage Facilities for Commuter Rail

Signals

- Upgrade signal system in Tower A interlocking to allow higher safe train speeds into North Station
- Restore fourth main line track from drawbridge over Charles River to junction between the Haverhill and Newburyport/Rockport Lines
- Improve remote control signals and crossovers on the Worcester Line
- Wellington Yard Switch and Cable Replacement (Orange Line)
- Park Street Signal Replacement (Green Line)

- Government Center Signal Replacement (Green Line)
- Boylston Signal Replacement (Green Line)
- Copley Signal Replacement (Green Line)
- Orange Line 14 Signal Upgrade
- Signals Annual Initiatives Program (third-rail heaters, etc.)
- Upgrade Signal System on the West Route Main Line
- Automatic Vehicle Identification on the Mattapan High Speed Line
- Prudential Signal Replacement (Green Line)
- Arlington Signal Replacement (Green Line)
- Airport and Government Center Crossover Control
- Upgrade Signal System from Beverly Junction to Gloucester Draw
- Harvard to Alewife Cable Replacement
- Hynes Convention Center Signal Replacement (Green Line)
- Haymarket Signal Replacement (Green Line)
- Operations Control Center Technology Re-Investment
- Green Line: Next-Generation Signal Study
- Orange Line: Third-Rail Heat for Track 1 between Community College and Wellington
- Orange Line: ATO Controller Test Stand for Safety/Reliability/Productivity (Prototype for Red)
- Interoperability Study - Systemwide Radio Project
- Green Line Study - Collision Avoidance System

Communications

- Cabot Rapid Transit Unit Substation Circuit Breaker Replacement
- Replace Eight Radio Base Stations

Power

- AC Cable/Duct Replacement 039-1, 0-39-2, 0-39-3
- AC Cable Duct Bank, Alewife to Porter
- Trackless Trolley Overhead Replacement
- Orange Line DC Breaker Upgrade
- Jet Replacement
- Red Line 480 Volt AC Cable Replacement
- Suspension Renewal - Commonwealth Avenue
- Orange Line 480 Volt AC Cable Replacement
- Wellington and Cabot DC Breakers
- Power Section Modifications
- Blue Line DC Feeder Cable Upgrade
- Systemwide Unit Substation Upgrades
- Replace Unit Substation - Long Wharf
- Haymarket Orange Line Electrical and Lighting System Replacement
- Section Insulator Replacement - Green and Blue Lines
- North Station Panel Board Circuit Breaker Replacement
- Cabot Trolley Bug 600 Volt DC Switchgear
- Harvard Station Feeders and Panel Board Replacement
- Davis Station Feeders and Panel Board Replacement
- 500 Arborway HVAC Upgrades
- Green Line: Chestnut Hill Avenue Catenary Pole Relocation, Signalization, and Switch Design Study
- Green Line Track Switch Heaters
- DC Circuit Trip Settings
- Wellington Transportation AC Replacement
- Wellington & Sullivan Transformer Replacement

- Replace 100 Hz Motor Generator Power Stations

Maintenance Facilities

- Orange Line: Infrastructure Required for New #14 Trains
- South Shore Garages
- Green Line: Car Washes - Riverside/Reservoir
- Orange Line: Truing Machine Required for New #14 Cars
- Repair Cabot Bus Garage Roof
- Wellington Carhouse Roof
- Mattapan Facility Upgrade
- Subway: Upgrade of All Carwashes
- Systemwide Vehicle Washer Upgrade
- Wellington Carhouse Sprinkler/Fire Alarm Upgrade
- Green Line: Riverside, Reservoir, and Lake Street Storage and Work Platform Mezzanine
- Red Line: Overhead Hoist Equipment Overhaul
- Cabot Yard Fire and Domestic Water Main Replacement
- MOW Storage Silo Replacement
- Orient Heights Car Yard and Maintenance Facility, Phase II
- Replace HVAC System - Wellington Carhouse
- Riverside Carhouse Upgrades
- Subway: Install and Update Lighting in All Yard Areas for Safety
- Everett Shops Improvement
- Everett: Replacement of Critical Machine Shop Equipment Lacking Required Safety Devices
- Wellington Signal Tower - HVAC Replacement
- Bus Wash Water Recycling
- Commuter Rail Maintenance Facility/Boston Engine Terminal (CRMF/BET) Leak Detection & Fuel/Water Line Replacement
- Replace Everett Compressor System
- Repair Water Main at Southside Service and Inspection Facility (S&I)
- Charlestown Bus Storm Drain System Repairs
- Everett: Replacement of Six Unreliable and Unsafe Overhead Cranes
- Everett: Critical Support Equipment Replacement for General Shop Services
- Reservoir Roof
- Mystic Junction Tank Removal
- Green Line: Yard Technology Study
- Modify CRMF Air Brake Room
- Rehabilitation of the Cathodic Protection System at South Side S&I
- Everett: Sandblast Booth for the Motor Room
- Orange Line: Procure a Parts Washer
- Orange Line: Install New Carhouse Security Doors: Study Door Re-Design

Stations

- New Emergency Smoke Vent Shafts in Downtown Crossing
- Station Rehabilitation & Enhancement Program
- Orient Heights Station Project
- Subway Stations Ventilation Improvements Program
- Back Bay Vent Fan Upgrade
- Southwest Corridor Orange Line Station Platform Repairs
- Kenmore Station Light Rail Accessibility Program and Surface Improvements
- Blue Line Platform Repairs
- Harvard Square Station Pavement Safety Improvement

- Safety Hazard Mitigation of Systemwide Busways
- Roxbury Crossing Station Roof
- Jackson Square Station Roof
- Oak Grove Station Pedestrian Walkway
- Massachussets Avenue Roof Replacement
- Sullivan Square Station Pavement Safety Improvement
- Reconstruction of Wollaston Lobby Drains
- Charles/MGH Station Accessibility and Modernization
- Replace Two Mini–High Platforms at Mansfield Station
- Maverick Square Station and Blue Line Vents
- Suffolk Station Footbridge and Ramps
- Braintree Lobby Floor Drains
- JFK Station Footbridge and Ramps
- Forest Hills Gutter and Roof System
- Alewife Emergency Ventilation Maintenance
- Systemwide Platform Ventilation Fans
- Improve Air Quality at Back Bay Station: Engineering Study
- Seven Station Engineering Study
- Bus Sign Reprogramming Process Efficiency Improvement
- Back Bay Station Expansion-Joint Replacement
- Courthouse - World Trade Center Headhouse Ventilation
- Replace the Stairways to the Platform at Newtonville Station
- Replace the Platform Pavement at Sharon Station
- Lighting Repairs at Back Bay Station Tracks 5 and 7
- Replace the Platform Pavement at Melrose Highlands Station
- Replace the Platform Pavement at Waverly Station
- Alewife Station Lobby Ventilators
- Green Line: Station Ventilation Technology Survey

Facilities

- Lighting - Systemwide Parking Lots
- Systemwide Busway Rehabilitation
- Storm Drain Replacement
- Quincy Center Retaining Wall Repairs
- Drainage System Repairs - Systemwide
- Red Line Sound Wall Repairs
- McSweeney Building Roof
- Systemwide Restroom Upgrade
- Systemwide Bird Control
- Systemwide Sprinkler Upgrade
- Hingham Commuter Boat Dock Replacement
- Systemwide Overhead Door Replacement
- Emergency Repair Services - Structural and General
- 45 High Street HVAC Upgrades
- 500 Arborway Roof
- Station Sewage Ejector Renovations
- Emergency Generator System Upgrades
- Systemwide Crossover Lighting Program
- Green Line: Improve Employee Facilities at Reservoir and Riverside
- Red Line: Upgrade Locker Room Facilities in Carhouse
- Route 3 Braintree Parking Lot Status Signs

- 1000 kw Portable Generator for 45 High Street
- CNG Detector - Alarm System Upgrades
- Special High-Reach Lifts for Electrical Maintenance
- Blue Line: Upgrade Bathrooms at Bowdoin Station

Bridges

- Reconstruction/Rehab of Gloucester Draw-bridge, Draw 1 East and West, and Savin Hill Underpass
- Merrimack River Bridge
- Construction/Rehab of Two Bridges: Beverly Draw and Shawsheen River
- Construction/Rehab of Three Bridges: Dean Road and Two Neponset River Bridges
- West Street Bridges
- Mechanical and Electrical Upgrade of Beverly Drawbridge
- Newport Avenue (Route 1A) Bridge Sidewalk Modification and Pedestrian Overpass Replacement
- Orange Line: Infrastructure Study on Dana Bridge

Accessibility

- Auburndale Commuter Rail Station Accessibility Improvements
- ADA Compliance - Green Line Track/Platforms
- Platform Edge/Detectable Warning Repairs/ Replacements - Systemwide
- Station Accessibility Enhancement
- Mobile Wheelchair Lifts Replacement
- Subway: Station Accessibility Train/Platform Bridgeplates Design

Technology

- Computer Technology Upgrade/Expansion
- Payment Card Industry and Data Security Standard Compliance
- PeopleSoft Timekeeping Project
- Absence Management Module in PeopleSoft Personnel Software
- Integration of Contract Management System with PeopleSoft
- Database Technology Standardization
- Data Transfer Initiative
- Business Center with State Compass Purchasing System
- Biometric Timeclocks
- Custom Trip Planner
- Bus and Subway Maintenance Portals and Kiosks
- Procurement and Installation of Maintenance System Portal
- Data Center Upgrades
- Bus Operations Vehicle Maintenance Software Upgrade
- MBTA Website Upgrades
- Replacement of Voice Mail System
- PeopleSoft-Payroll E-Pay Project

Appendix I

Modeling Summary Results

In addition to the illustrative scenarios that were discussed in Chapter 7, project-level analysis was also completed for enhancement and expansion projects. The results of this project-level analysis are reported in this appendix. In addition to the projects included in the illustrative scenarios, this appendix also lists some projects that that were not in any of the scenarios but were discussed in Chapter 6. There are a few projects that are not included in this appendix because, for the most part, they either have not entered the conceptual planning process or are still in the very early stages of that process.

TABLE I-1
Results of Individual Project Modeling: Ridership

	Projects	Corridor	Change in Transit Ridership				Diversions from Auto Mode		Reduction in Transfers	Increase in Transit Mode Share		Travel Time Savings		Reduction in VMT	
			Linked Trips		Unlinked Trips										
			Low	High	Low	High	Low	High	Yes/No	Low	High	Low	High	Low	High
Enhancement Scenario	Route 1 BRT: Harvard-Dudley	Northwest	3,000	4,000	4,500	6,000	3,000	4,000	N	.018%	.024%	2,400	3,200	15,600	20,800
	Route 22 BRT: Ashmont-Ruggles	Circumferential	1,900	2,600	2,850	3,900	1,900	2,600	N	.012%	.016%	1,500	2,100	9,880	13,520
	Route 31 BRT: Mattapan-Forest Hills	Southwest	400	600	600	900	400	600	N	.002%	.004%	300	500	2,080	3,120
	Route 32 BRT: Wolcott Sq.-Forest Hills	Southwest	900	1,200	1,350	1,800	900	1,200	N	.005%	.007%	700	1,000	4,680	6,240
	Route 39 BRT: Forest Hills-Back Bay	Southwest	1,600	2,200	2,400	3,300	1,600	2,200	N	.010%	.013%	1,300	1,800	8,320	11,440
	Route 57 BRT: Watertown-Kenmore	West	1,800	2,400	2,700	3,600	1,800	2,400	N	.011%	.015%	1,400	1,900	9,360	12,480
	Route 66 BRT: Harvard-Dudley	Circumferential	2,900	3,900	4,350	5,850	2,900	3,900	N	.018%	.024%	2,300	3,100	15,080	20,280
	Route 71 BRT: Watertown Sq.-Harvard	Northwest	700	1,000	1,050	1,500	700	1,000	N	.004%	.006%	600	800	3,640	5,200
	Route 73 BRT: Waverley-Harvard	Northwest	600	900	900	1,350	600	900	N	.004%	.005%	500	700	3,120	4,680
	Route 77 BRT: Arlington Hghts.-Harvard	Northwest	2,100	2,800	3,150	4,200	2,100	2,800	N	.013%	.017%	1,700	2,200	10,920	14,560
	Route 111 BRT: Woodlawn-Haymarket	Northeast	1,900	2,600	2,850	3,900	1,900	2,600	N	.012%	.016%	1,500	2,100	9,880	13,520
	Alewife access busways	Northwest	300	500	1,000	1,300	240	400	N	.002%	.003%	30	50	1,600	2,200
	1000 New Park-and-Ride Spaces	Systemwide	300	400	450	600	300	400	N	.002%	.002%	180	240	6,360	8,480
	Assembly Sq. Orange Line Station	North	2,100	2,900	2,700	3,800	2,100	2,900	Y	.013%	.018%	400	500	8,820	15,080
	Improved Orange Line Frequencies	North	900	1,200	3,600	4,900	900	1,200	N	.005%	.007%	900	1,300	4,680	6,240
	Yawkey Station upgrade	West	30	40	130	170	30	40	N	nm*	nm*	nm*	nm*	276	368
	Ruggles Station expansion	Southwest	260	350	1,300	1,800	220	290	N	.002%	.002%	300	400	2,024	2,668
	Fitchburg Line Improvements	Northwest	300	500	1,300	1,700	540	720	N	.002%	.003%	900	1,200	7,700	10,200
	Worcester Line Service Improvements	West	400	600	1,000	1,300	420	540	N	.002%	.004%	440	660	6,000	7,700

TABLE I-1 (cont.)
Results of Individual Project Modeling: Ridership

	Projects	Corridor	Change in Transit Ridership				Diversions from Auto Mode		Reduction in Transfers	Increase in Transit Mode Share		Travel Time Savings		Reduction in VMT	
			Linked Trips		Unlinked Trips										
			Low	High	Low	High	Low	High	Yes/No	Low	High	Low	High	Low	High
Expansion Scenario	Fairmount Line improvements	Southwest	100	200	2,300	3,000	100	200	Y	.001%	.001%	330	430	520	1,040
	Green Line to Medford	Northwest	6,500	8,900	-1,400	-1,800	5,300	7,100	Y	.039%	.054%	6,800	9,200	22,600	30,600
	Urban Ring	Circumferential	42,500	57,500	112,500	152,100	30,400	41,200	Y	.258%	.349%	21,300	28,800	127,680	173,040
	Blue Line extension	Northeast	3,400	4,600	6,800	9,200	3,400	4,600	N	.021%	.028%	3,100	4,300	40,800	55,200
	Silver Line Phase III	Central	15,800	21,400	43,400	58,800	8,500	11,500	N*	.096%	.130%	14,600	19,800	61,300	82,800
	Dudley South BRT extension	Southeast	1,400	1,800	-11,600	-15,900	1,400	1,800	Y	.008%	.011%	1,100	1,400	7,280	9,360
	Nashua/Manchester extension	North	6,300	8,500	7,000	9,500	6,300	8,500	N	.038%	.052%	570	770	121,900	164,900
	Plaistow extension	North	2,700	3,600	3,400	4,600	2,400	3,300	N	.016%	.022%	320	430	54,800	74,100
	T. F. Green extension	Southwest	800	1,000	1,300	1,800	800	1,000	N	.005%	.006%	310	420	8,900	12,000
	Red-Blue connector	Central	**	**	**	**	**	**	**	**	**	**	**	**	**
	South Coast Rail	Southwest	***	***	***	***	***	***	***	***	***	***	***	***	***
Other Projects	North-South Rail Link	Central	44,900	60,700	95,300	128,900	40,500	54,900	Y	.272%	.368%	38,100	51,600	369,100	499,400
	Commuter rail to Gardner	Northwest	**	**	**	**	**	**	**	**	**	**	**	**	**
	Green Line to Needham	West	1,000	1,400	6,900	9,400	900	1,200	Y	.006%	.008%	48	65	4,417	5,975
	Commuter rail to Wareham	Southeast	2,800	3,700	3,100	4,100	2,800	3,700	N	.017%	.022%	tbd	tbd	90,340	122,225
	Commuter rail electrification	Systemwide	8,900	12,100	21,300	28,800	8,900	12,100	N	.054%	.073%	9,700	13,100	11,130	15,060

* Not meaningful

** New analysis in progress

*** Analysis ongoing – preferred alternative not yet selected

TABLE I-2
Results of Individual Project Modeling: Air Quality

	Projects	Corridor	Reduction in Kilograms of CO_2 (transit + auto)		Reduction in Kilograms of CO (transit + auto)		Reduction in Kilograms of VOC (transit + auto)		Reduction in Kilograms of NO_x (transit + auto)		Reduction in Kilograms of PM_{10} (transit + auto)		Reduction in Kilograms of $PM_{2.5}$ (transit + auto)	
			Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Enhancement Scenario	Route 1 BRT: Harvard-Dudley	Northwest	8,883	11,844	46.8	62.4	3.09	4.12	2.36	3.14	0.43	0.57	0.20	0.26
	Route 22 BRT: Ashmont-Ruggles	Circumferential	5,626	7,698	29.7	40.6	1.96	2.68	1.49	2.04	0.27	0.37	0.13	0.17
	Route 31 BRT: Mattapan-Forest Hills	Southwest	1,184	1,777	6.2	9.4	0.41	0.62	0.31	0.47	0.06	0.09	0.03	0.04
	Route 32 BRT: Wolcott Sq.-Forest Hills	Southwest	2,665	3,553	14.0	18.7	0.93	1.24	0.71	0.94	0.13	0.17	0.06	0.08
	Route 39 BRT: Forest Hills-Back Bay	Southwest	4,737	6,514	25.0	34.3	1.65	2.27	1.26	1.73	0.23	0.31	0.11	0.15
	Route 57 BRT: Watertown-Kenmore	West	5,330	7,100	28.1	37.5	1.85	2.47	1.41	1.88	0.26	0.34	0.12	0.16
	Route 66 BRT: Harvard-Dudley	Circumferential	8,587	11,547	45.3	60.9	2.99	1.02	2.28	3.06	0.41	0.56	0.19	0.26
	Route 71 BRT: Watertown Sq.-Harvard	Northwest	2,073	2,961	10.9	15.6	0.72	1.03	0.55	0.79	0.10	0.14	0.05	0.07
	Route 73 BRT: Waverley-Harvard	Northwest	1,777	2,665	9.4	14.0	0.62	0.93	0.47	0.71	0.09	0.13	0.04	0.06
	Route 77 BRT: Arlington Hghts.-Harvard	Northwest	6,218	8,290	32.8	43.7	2.16	2.88	1.65	2.20	0.30	0.40	0.14	0.18
	Route 111 BRT: Woodlawn-Haymarket	Northeast	5,626	7,698	29.7	40.6	1.96	2.68	1.49	2.04	0.27	0.37	0.13	0.17
	Alewife access busways	Northwest	911	1,253	4.8	6.6	0.32	0.44	0.24	0.33	0.04	0.06	0.02	0.03
	1000 New Park-and-Ride Spaces	Systemwide	3,621	4,829	19.1	25.5	1.26	1.68	0.96	1.28	0.17	0.23	0.08	0.11
	Assembly Sq. Orange Line Station	North	5,022	8,587	26.5	45.3	1.73	2.99	1.33	2.28	0.24	0.41	0.11	0.19
	Improved Orange Line Frequencies	North	2,665	3,553	14.0	18.7	0.93	1.24	0.71	0.94	0.13	0.17	0.06	0.08
	Yawkey Station upgrade	West	157	210	0.8	1.1	0.05	0.07	0.04	0.06	0.01	0.01	nm	nm
	Ruggles Station expansion	Southwest	1,152	1,519	6.1	8.0	0.40	0.53	0.31	0.40	0.06	0.07	0.03	0.03
	Fitchburg Line Improvements	Northwest	4,384	5,808	23.1	30.0	1.52	2.02	1.16	1.54	0.21	0.28	0.10	0.13
	Worcester Line Service Improvements	West	3,416	4,384	18.0	23.1	1.19	1.52	0.91	1.16	0.16	0.21	0.08	0.10

TABLE I-2 (cont.)
Results of Individual Project Modeling: Air Quality

	Projects	Corridor	Reduction in Kilograms of CO_2 (transit + auto)		Reduction in Kilograms of CO (transit + auto)		Reduction in Kilograms of VOC (transit + auto)		Reduction in Kilograms of NO_x (transit + auto)		Reduction in Kilograms of PM_{10} (transit + auto)		Reduction in Kilograms of $PM_{2.5}$ (transit + auto)	
			Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Expansion Scenario	Fairmount Line improvements	Southwest	298	592	1.6	3.1	0.10	0.20	0.08	0.16	0.01	0.03	0.01	0.01
	Green Line to Medford	Northwest	12,900	16,400	190.6	256.5	5.95	8.05	3.40	4.60	0.60	0.81	0.30	0.40
	Urban Ring	Circumferential	72,701	98,529	383.2	519.3	25.28	34.26	19.28	26.13	3.50	4.74	1.62	2.20
	Blue Line extension	Northeast	23,232	43,431	122.4	165.7	85.08	10.93	6.16	8.34	1.12	1.51	0.52	0.70
	Silver Line Phase III	Central	34,847	47,146	183.7	248.5	12.12	16.39	9.24	12.50	1.68	2.27	0.78	1.05
	Dudley South BRT Extension	Southeast	4,145	5,330	21.9	28.1	1.44	1.85	1.10	1.41	0.20	0.26	0.09	0.12
	Nashua/Manchester extension	North	61,864	83,698	992.8	1343.2	21.55	29.15	-16.10	-11.90	2.86	3.86	1.08	1.46
	Plaistow extension	North	29,458	39,856	450.5	609.5	9.86	13.34	1.19	1.61	1.39	1.89	0.59	0.79
	T. F. Green extension	Southwest	1,851	2,504	63.7	86.1	1.22	1.60	-19.55	-14.45	-0.02	-0.02	-0.18	-0.14
	Red-Blue connector	Central	**	**	**	**	**	**	**	**	**	**	**	**
	South Coast Rail	Southwest	***	***	***	***	***	***	***	***	***	***	***	***
Other Projects	North-South Rail Link	Central	210,200	284,400	3069.4	4152.7	67.15	90.85	52.70	70.30	5.10	6.90	10.20	13.80
	Commuter rail to Gardner	Northwest	**	**	**	**	**	**	**	**	**	**	**	**
	Green Line to Needham	West	2,515	3,403	36.6	49.5	0.85	1.15	0.85	1.15	nm *	nm *	nm *	nm *
	Commuter rail to Wareham	Southeast	39,000	52,800	703.00	951.00	15.00	20.20	-64.90	-47.90	1.48	2.00	0.18	0.24
	Commuter rail electrification	Systemwide	7,539	10,200	1544.0	2089.0	368.10	498.00	6487.35	8777.00	34.71	46.95	33.51	45.33

* Not meaningful

** New analysis in progress

*** Analysis ongoing – preferred alternative not yet selected